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Studies in the genus *Lotononis* (Crotalarieae, Fabaceae). 2. Three new species of the section *Telina* from the Cape Province

B-E. VAN WYK*

Keywords: Cape Province, Fabaceae, *Lotononis* section *Telina*, new taxa

ABSTRACT

Three new species of the section *Telina* (E. Mey.) Benth. of *Lotononis* (DC.) Eckl. & Zeyh. are described: *L.* **azureoides** B-E. van Wyk, *L.* **gracilifolia** B-E. van Wyk and *L.* **lamprifolia** B-E. van Wyk. These species appear to be very rare and are known from only a few localities in marginal fynbos areas of the south-western and southern Cape.

UITTREKSEL

Drie nuwe soorte van die seksie *Telina* (E. Mey.) Benth. van *Lotononis* (DC.) Eckl. & Zeyh. word beskryf: *L.* **azureoides** B-E. van Wyk, *L.* **gracilifolia** B-E. van Wyk en *L.* **lamprifolia** B-E. van Wyk. Hierdie soorte skyn baie skaars te wees en is bekend van slegs enkele lokaliteite in marginale fynbosgebiede van die Suidwes- en Suid-Kaap.

INTRODUCTION

The section *Telina* (E. Mey.) Benth. of *Lotononis* (DC.) Eckl. & Zeyh. comprises a group of prostrate or procumbent suffrutices easily recognized by their large, usually solitary flowers that are borne on long slender peduncles. The very large standard petal is a particularly useful diagnostic character.

Meyer (1836) included this group as one of three sections in his genus *Telina,* namely the section *Chasmoneae*. When Bentham (1843) changed the status of *Telina* to a section of *Lotononis,* he excluded the sections *Cytisoides* and *Brachypodae* and referred both of these to the section *Krebsia* (Eckl. & Zeyh.) Benth. *Chasmoneae* E. Mey. and *Telina* (E. Mey.) Benth. are therefore synonymous. Most of the species which Ecklon & Zeyher (1836) included in their concept of *Lotononis* belong to this section.

The section as circumscribed by Dümmer (1913) is not a natural group. Polhill (1973) and Van Wyk (1987) respectively, transferred *Lotononis bracteata* Benth. to *Pearsonia* Dümmer and *L. magnistipulata* Dümmer to *Argyrolobium* Eckl. & Zeyh. Some more changes are necessary, but these will be motivated elsewhere (Van Wyk in prep.). My own concept of the group does not include *L. minor* Dümmer & Jennings, *L. macrocarpa* Eckl. & Zeyh., *L. solitudinis* Dümmer and *L. marlothii* Engl. It does however include the three new species that are described below.

Lotononis azureoides *B-E. van Wyk,* sp. nov., *L. azureae* Eckl. & Zeyh. similis, sed habitu denso ramosissimo, foliolis conduplicatis valde recurvatis, stipulis anguste lanceolatis, inflorescentiis subterminalibus (in speciebus omnibus aliis *Telinae* foliis oppositis) atque vexillo pro ratione parvo carinam aequanti (vexillum quam carina valde longius in speciebus omnibus aliis *Telinae*) differt.

TYPE.—Cape, 3222 (Beaufort West): Beaufort West, Karoo National Park, at Blouput on steep rocky and bouldery sandstone slope (–BC), 2.11.1984, *Bengis 442* (PRE, charta 1, holo.; PRE, charta 2, iso.).

Procumbent, densely branched shrublet, ± 0,3 m wide. *Branches* smooth, glabrous; twigs densely strigillose, conspicuously white at the ends. *Leaves* digitately trifoliolate; petiole (2–) 3–4 (–7) mm long; leaflets conduplicate, strongly recurved, obovate, (2–) 4–6 (–8) × (1–) 2–3 (–5) mm, abaxially strigillose, adaxially glabrous. *Stipules* consistently present, single at each node, elliptic-oblong to narrowly lanceolate, 2–3 (–5) mm long. *Inflorescences* terminal or subterminal on lateral branches, slender, long-pedunculate, 25–40 mm long, invariably single-flowered; bracts small, up to 1 mm long; bracteoles absent. *Flowers* 12–14 mm long, deep blue; pedicel 2–3 mm long. *Calyx* 7–8 mm long, with the upper and lateral lobes on either side fused higher up in pairs, minutely strigillose. *Standard* broadly ovate to orbicular, 11–13 mm long, with a line of hairs dorsally along the middle, deep blue with yellow at the base. *Wing petals* oblanceolate, slightly longer than the keel; apex obliquely truncate; sculpturing upper basal and upper left central, in 4 rows of inter- and intracostal lunae. *Keel petals* semicircular, obtuse, auriculate and pocketed near the base. *Anthers* dimorphic. *Pistil* 12–14 mm long; ovary linear, 8–10 mm long. *Fruit* (slightly immature) 20 × 4–5 mm, laterally much inflated, lower suture sunken, upper suture verrucose, surface wrinkled, glabrous. *Seed* unknown. Figure 1.

This species is similar to *L. azurea* Eckl. & Zeyh. but differs in the dense and much branched habit, the conduplicate and strongly recurved leaflets, the narrowly lanceolate stipules, the subterminal inflorescences (leaf-opposed in all other species of *Telina*) and the relatively small standard petal, which is as long as the keel (standard petal much longer than the keel in all other species of *Telina*). The flower structure is reminiscent of some species in the section *Polylobium* (Eckl. & Zeyh.) Benth., but the slender single-flowered inflorescence and the shape of the calyx and wing petals are typical of other species in the section *Telina*.

L. azureoides is known only from two collections from the Nuweveld Mountains at Beaufort West (Figure 2). It was found on a rocky south-eastern slope in grassy dwarf shrubland at an altitude of 1 600 m. The specific

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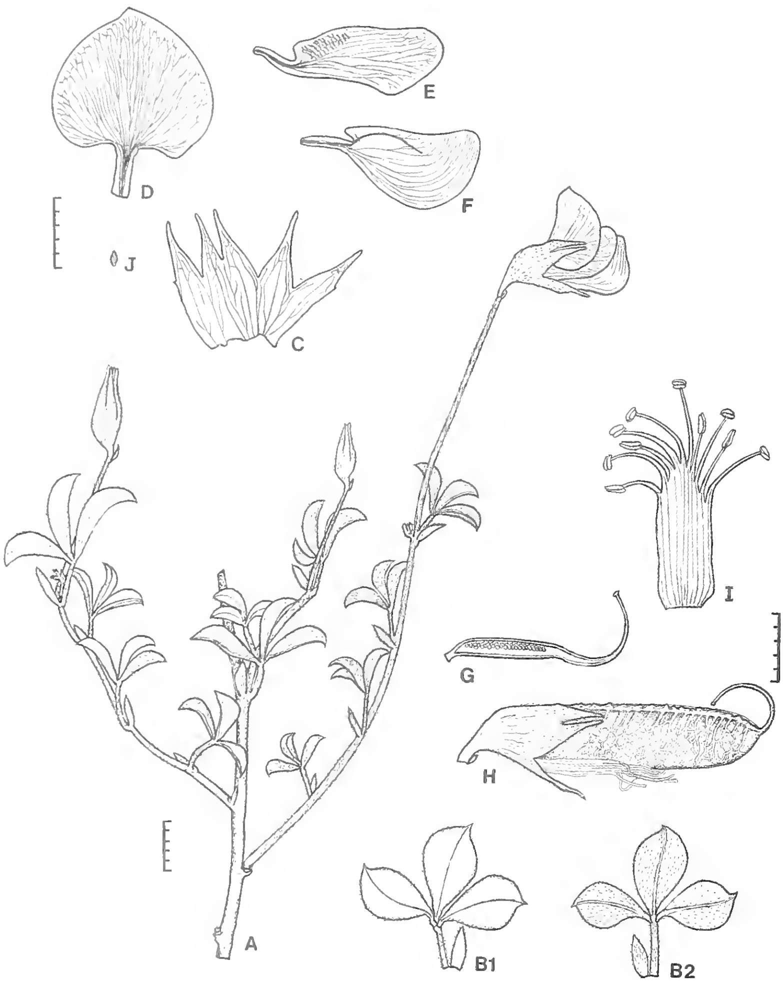

FIGURE 1.—*Lotononis azureoides*. A, flowering branch, showing the slender peduncles and conduplicate, recurved leaflets; B1, B2, leaves with leaflets opened out, showing the single stipule and sparsely strigillose vestiture: B1, adaxial view, B2, abaxial view; C, calyx opened out, with the upper lobes to the left, vestiture not shown; D, standard petal; E, wing petal; F, keel petal; G, pistil; H, fruit (slightly immature), showing the wrinkled surface and verrucose upper suture; I, androecium; J, bract (all from *Bengis 442*). Scales in mm.

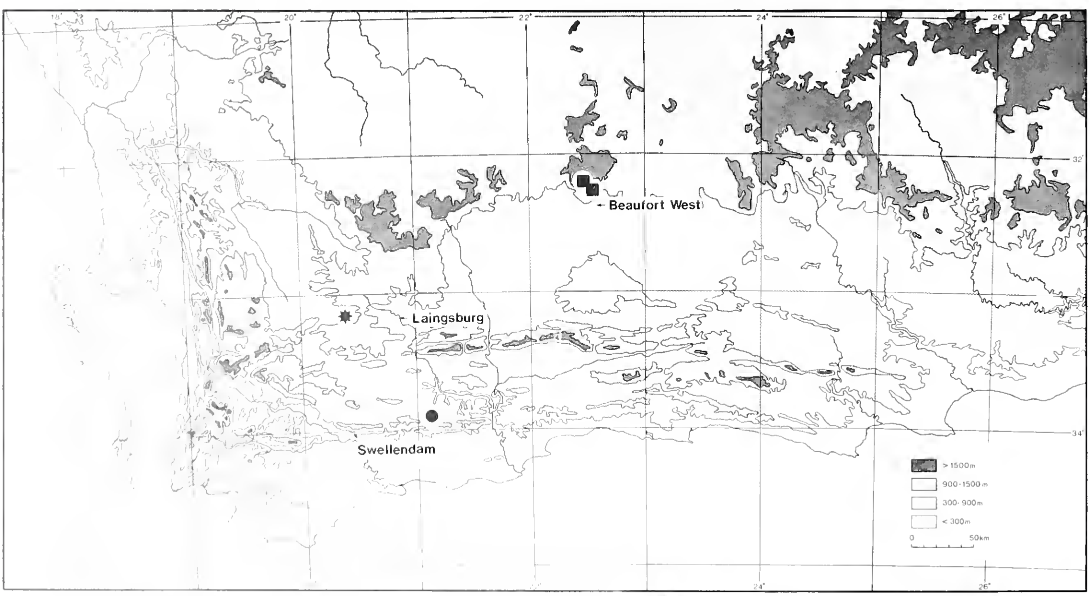

FIGURE 2.—The known geographical distribution of *Lotononis azureoides*, ■; *L. gracilifolia*, ★; and *L. lamprifolia*, ●.

epithet suggests a similarity with *L. azurea* Eckl. & Zeyh. which it superficially resembles, but the affinities of the species are not clear. More material is needed for a detailed study. Available evidence indicates that the *Telina*-type flower and inflorescence have evolved more than once from different lines in the sections *Aulacinthus* (E. Mey.) Benth. and *Polylobium*. The distinction between the latter two sections and indeed also the section *Telina* is becoming more and more obscured. Some newly discovered species such as *L. azureoides* have combinations of those characters previously used diagnostically for each of the three sections.

CAPE.—3222 (Beaufort West): Nuweveld Mountain, Mountain view, roadside near FM tower (−AB), *D. Shearing 2.2.85* (private herbarium on the farm Layton, Fraserburg District); Beaufort West, Karoo National Park, at Blouput on steep rocky and bouldery sandstone slope (−BC), 2.11.1984, *Bengis 442* (PRE, holo.; PRE, iso.).

Lotononis gracilifolia *B-E. van Wyk,* sp. nov., *L. argenteae* Eckl. & Zeyh. et speciebus aliis sectionis *Telinae* similis, sed distinctissima foliolis gracilibus acicularibus, stipulis inconspicuis, lobis calycis subulatis. *L. dissitinodi* B-E. van Wyk (sectionis *Aulacinthus*) valde similis sed habitu nano suffrutescente, foliolis valde angustioribus, stipulis inconspicuis, pedunculis longioribus et lobis calycis angustissimis differt.

TYPE.—Cape, 3320 (Montagu): Laingsburg District, Tweedside (−AB), 27.9.1951, *Barker 7482* (NBG, charta 2, holo.; NBG, charta 1, iso.).

Dwarf suffrutescent perennial up to 0,15 m tall. *Branches* procumbent from a central rootstock; sparsely branched and sparsely leafy; young twigs densely silky-sericeous. *Leaves* digitately trifoliolate, very slender, densely silky-sericeous; petiole up to 22 mm long; leaflets acicular, variable in length, (2−) 7−15 (−25) mm long, slightly conduplicate, almost terete. *Stipules* inconspicuous, caducous, rarely present, up to 0,5 mm long when present. *Inflorescences* subterminal or leaf-opposed on short lateral branches, 1-flowered, rarely 2-flowered; peduncle slender, variable in length, (3−) 20−50 (−60) mm long; bract small, oblong, up to 2 mm long; bracteoles absent. *Flowers* large, up to 18 mm long, yellow; pedicel 2−4 mm long. *Calyx* 10−13 mm long; lobes long, subulate, with the lateral ones on either side fused higher up in pairs, densely sericeous. *Standard* very large, broadly ovate to orbicular, 18−20 mm

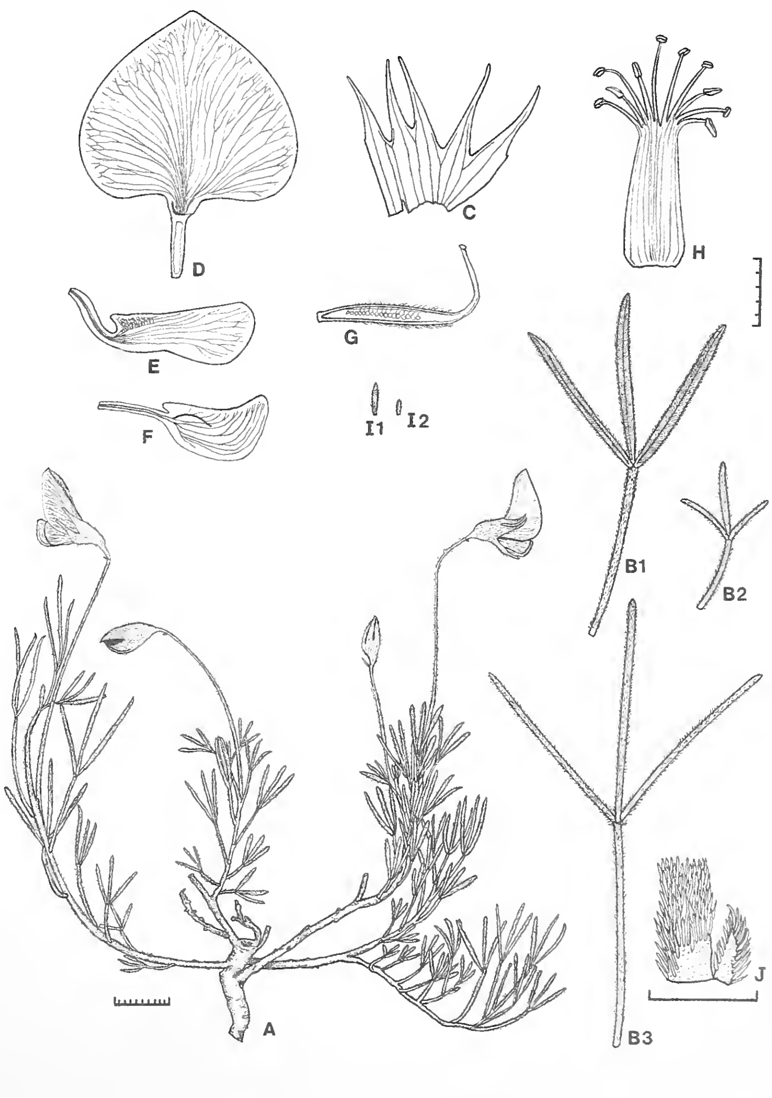

FIGURE 3.—*Lotononis gracilifolia*. A, habit, showing the procumbent flowering branches, acicular leaves and slender peduncles; B1, leaf in adaxial view, with leaflets opened out, B2, B3, leaves in abaxial view, showing variation in size, leaflets not opened out; C, calyx opened out with upper lobes to the left, showing fusion of the lateral lobes; D, standard petal; E, wing petal; F, keel petal; G, pistil; H, androecium; I1, I2, bracts; J, petiole base with vestiture partly removed to show the single, inconspicuous stipule (all from *Barker 7482*). Scales in mm.

long, with hairs dorsally along the middle. *Wing petals* as long or slightly longer than the keel, oblanceolate, ± 15 mm long; apex obliquely obtuse; sculpturing upper basal, in 3–4 rows of mostly intercostal lunae. *Keel petals* semicircular, obtuse, auriculate and pocketed near base. *Anthers* dimorphic. *Pistil* long; ovary linear, ± 10 mm long. *Fruit* and *seed* unknown. Figure 3.

This species is similar to *L. argentea* Eckl. & Zeyh. and other species of the section *Telina,* but it is very distinct in the acicular leaflets, the inconspicuous stipules and the subulate calyx lobes. It is remarkably similar to *L. dissitinodis* B-E. van Wyk (section *Aulacinthus*), but differs from this species in the dwarf and suffrutescent habit, the much narrower leaflets, the inconspicuous stipules, the longer peduncles and the very narrow calyx lobes.

L. gracilifolia appears to be a very rare species and is only known from the type collection (Figure 2). I have so far been unable to locate the plant. The slender, acicular leaves are a useful diagnostic character and the species is unlikely to be confused with any other. This very distinctive character has suggested the specific epithet.

CAPE.—3320 (Montagu): Tweedside, Laingsburg (–AB), 27.9.1951, *Barker 7482* (NBG, holo.; NBG, iso.).

Lotononis lamprifolia *B-E. van Wyk,* sp. nov., *L. argenteae* valde affinis, sed habitu diffusiore, stipulis obovatis foliolis valde similibus (in *L. argentea* linearibus vel lanceolatis), floribus flavis (in *L. argentea* caeruleis) et vexillo depresso ovato (in *L. argentea* late ovato vel orbiculato; etiam *L. acuminatae* Eckl. & Zeyh. similis, sed ab hac specie indumento dense sericeo et petiolis valde longioribus differt.

TYPE.—Cape, 3321 (Ladismith): Riversdale and Swellendam Districts, between Muiskraal and Lemoenshoek (–CC), 6.8.1951, *Barker 7374* (NBG, holo.).

Dwarf suffrutescent perennial ± 0,2 m tall. *Branches* sparse, woody at the base; young twigs densely sericeous. *Leaves* digitately trifoliolate, densely and silvery sericeous; petiole relatively thick, variable in length, 3–4 (–10) mm long, leaflets oblanceolate to obovate, (3–) 4–5 (–8) mm long, slightly conduplicate, thick in texture. *Stipules* present or absent; when present closely resembling the leaflets in shape, size and vestiture, usually single to each node, strongly persistent. *Inflorescences* leaf-opposed on short lateral branches, invariably single-flowered; peduncle slender, 18–35 mm

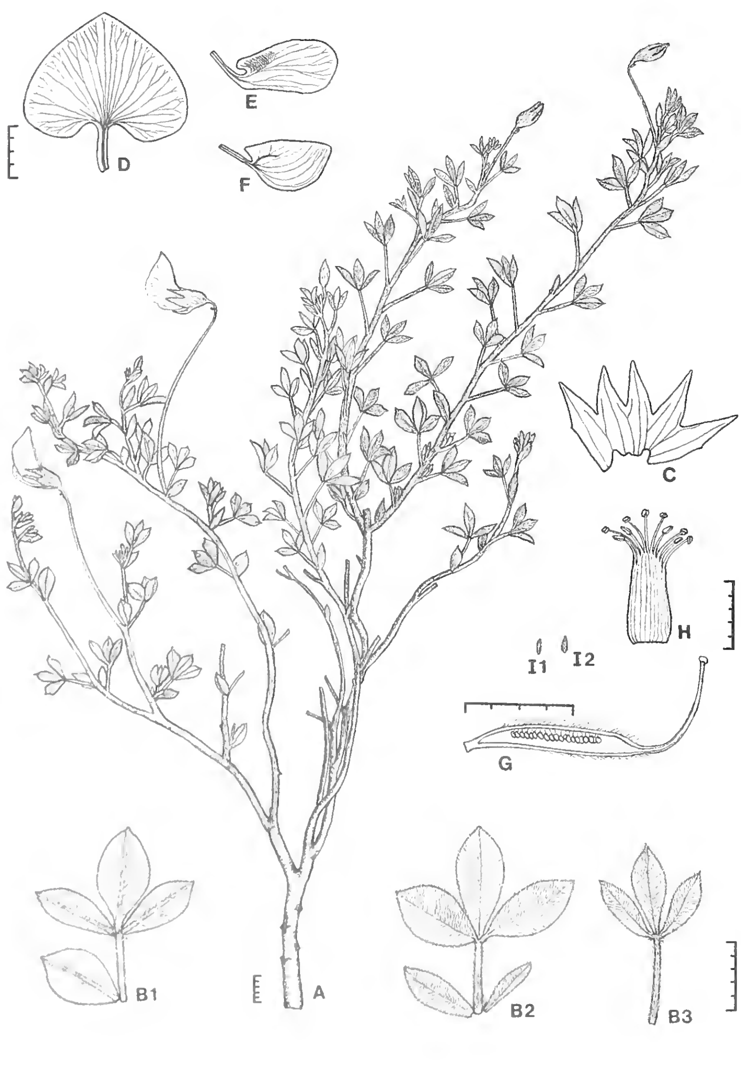

FIGURE 4.—*Lotononis lamprifolia*. A, habit; B1, B2, B3, leaves: B1, abaxial view, showing the single stipule and sericeous vestiture; B2, adaxial view, showing paired stipules; B3, adaxial view, stipules absent; C, calyx opened out, upper lobes to the left, showing the very slight fusion of the lateral lobes; D, standard petal (note the shape); E, wing petal; F, keel petal; G, pistil; H, androecium; I1, I2, bracts (all from *Barker 7374*). Scales in mm.

long; bracts small, oblong, ± 1 mm long; bracteoles absent. *Flowers* 10–12 mm long, yellow; pedicel 1–2 mm long. *Calyx* 6–7 mm long; lobes triangular, with the lateral ones on either side fused only slightly higher up in pairs, densely sericeous. *Standard* large, broadly depressed ovate, ± 12 mm long, with hairs dorsally along the middle. *Wing petals* longer than the keel, broadly oblanceolate, ± 10 mm long; apex obtuse, rounded; sculpturing upper basal and upper left central, in 4–5 rows of mostly intercostal lunae. *Keel petals* semicircular, obtuse, auriculate and pocketed near base. *Anthers* dimorphic. *Pistil* short; ovary linear, ± 7 mm long. *Fruit* and *seed* unknown. Figure 4.

This species is closely related to *L. argentea* Eckl. & Zeyh. but differs in the more diffuse habit, the obovate stipules which closely resemble the leaflets (linear to lanceolate in *L. argentea*), the yellow flowers (blue in *L. argentea*) and the depressed ovate standard (widely ovate to orbicular in *L. argentea*). It is also similar to *L. acuminata* Eckl. & Zeyh. but differs from this species in the densely sericeous vestiture and the much longer petioles.

L. lamprifolia is only known from a single specimen collected along the northern foothills of the Langeberg near Barrydale (Figure 2). The shining and silky appearance of the leaflets is very distinct (as in *L. argentea*), hence the specific epithet. The latter species is also very poorly represented in southern African herbaria and collectors are requested to look out for more complete material. Fruiting material in particular is required for a more detailed study of the full range of variation in these two closely related species and to verify the diagnostic features of the new species.

CAPE.—3321 (Ladismith): Riversdale and Swellendam Districts, between Muiskraal and Lemoenshoek (–CC), 6.8.1951, *Barker 7374* (NBG, holo.)

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I wish to thank Dr H. F. Glen (Botanical Research Institute, Pretoria) for the Latin translations and the Directors and staff of the cited herbaria for the loan of specimens. The taxonomic study of *Lotononis* is a registered Ph. D. project at the University of Cape Town.

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Bothalia 19,1: 7–8 (1989)

Studies in the genus *Lotononis* (Crotalarieae, Fabaceae). 5. A new species of the *L. involucrata* group (section *Polylobium*) from the north-western Cape Province

B–E. VAN WYK*

Keywords: Cape Province, Fabaceae, *Lotononis* section *Polylobium*, new taxon

ABSTRACT

A new species of the section *Polylobium* (Eckl. & Zeyh.) Benth. of *Lotononis* (DC.) Eckl. & Zeyh. is described, namely *L.* **racemiflora** B–E. van Wyk. The species, known only from a single collection near Clanwilliam in the north-western Cape, is closely related to *L. involucrata* (Berg.) Benth. and *L. angustifolia* (E. Mey.) Steud.

UITTREKSEL

'n Nuwe soort van die seksie *Polylobium* (Eckl. & Zeyh.) Benth. van *Lotononis* (DC.) Eckl. & Zeyh. word beskryf, naamlik, *L.* **racemiflora** B–E. van Wyk. Die soort, wat slegs bekend is van 'n enkele versameling naby Clanwilliam in die Noord-wes Kaap, is naverwant aan *L. involucrata* (Berg.) Benth. en *L. angustifolia* (E. Mey.) Steud.

INTRODUCTION

Lotononis involucrata (Berg.) Benth. and related species differ from other species of the section *Polylobium* (Eckl. & Zeyh.) Benth. in the subterranean caudex from which flowering shoots develop annually. Stipules are paired or absent and never single or markedly dimorphic as in other species. The umbellate inflorescence in all the species which Dümmer (1913) included in *Polylobium* was used as a diagnostic character for the section.

The new species described below is morphologically intermediate between *L. involucrata* (Berg.) Benth. and *L. angustifolia* (E. Mey.) Steud. and is obviously very closely related to these species. However, the inflorescence is a true raceme. Inflorescence structure is therefore no longer a useful diagnostic character for distinguishing the section *Polylobium*. It may indeed be argued that *Polylobium sensu lato* is an artificial group which has resulted from the excessive weighting of inflorescence structure as a diagnostic character.

Lotononis racemiflora *B–E. van Wyk*, sp. nov., *L. angustifoliae* (E. Mey.) Steud. valde similis, sed inflorescentia multiflora racemosa (in *L. angustifolia* pauciflora umbellata vel subumbellata), basi stipulae semicordato, indumento densiore piloso differt; etiam *L. involucrata* (Berg.) Benth. similis, sed ab hac specie inflorescentia racemosa, foliolorum amplitudine texturaque (quam in *L. involucrata* maioribus coriaceoribus), stipularum amplitudine formaque, vexillo alisque multo maioribus differt.

TYPE.—Cape, 3218 (Clanwilliam): Clanwilliam District, Bokwater, W of Clanwilliam (–BB), 28.10.1948, *Acocks 15171* (PRE, holo.; K, iso.).

Suffrutescent herb, with annual flowering branches from a woody root. *Branches* procumbent, up to 0,3 m long, thick and rigid, densely leafy, more sparsely so towards the base, densely pilose. *Leaves* digitately trifoliolate, densely and softly pilose; petiole (3–) 8–12 (–14) mm long; leaflets linear to narrowly elliptical, (4–) 10–18 (–22) × 2–2,5 mm, with soft pilose hairs on both surfaces. *Stipules* similar to the leaflets, consistently present, paired at each node, ovate to lanceolate, (3–) 8–10 (–12) mm long; base distinctly semicordate; apex obtuse to acute. *Inflorescences* terminal on primary and secondary branches, racemose, lax, 90–140 mm long, up to 18-flowered; peduncle 28–50 mm long, densely and softly pilose; rachis up to 95 mm long, bracts conspicuous, thickly textured, ovate-cymbiform, up to 8 × 3 mm, pilose on both surfaces; bracteoles absent. *Flowers* large, 14–16 mm long, yellow; pedicel 3–5 mm long. *Calyx* 12–14 mm long, lobes narrowly acuminate, with the lateral ones on either side fused higher up in pairs, lanately pilose. *Standard* large, suborbicular, 15 mm long, longitudinally striated, base broadly cordate. *Wing petals* broadly obovate, much longer than the keel; apex obliquely rounded; sculpturing upper basal and upper central, in 7–8 rows of mostly intercostal lunae and lamellae. *Keel petals* small, semicircular, 11–12 mm long, auriculate and pocketed near the base; apex acute. *Anthers* dimorphic. *Pistil* 11–12 mm long; ovary oblong-linear, 6–7 mm long, pubescent. *Fruit* (immature) oblong-linear, twice as long as the calyx, much inflated laterally, sparsely pubescent, with evenly spaced warty protuberances along the upper suture. *Seed* unknown. Figure 1.

L. racemiflora is closely related to *L. angustifolia* but differs in the many-flowered racemose inflorescence (few-flowered and umbellate or subumbellate in *L. angustifolia*), the semicordate stipule base and the more densely pilose vestiture. It is also similar to *L. involucrata*, but differs from this species in the racemose inflorescence, the size and texture of the leaflets (larger and more coriaceous than in *L. involucrata*), the size and shape of the stipules and the much larger standard and wing petals.

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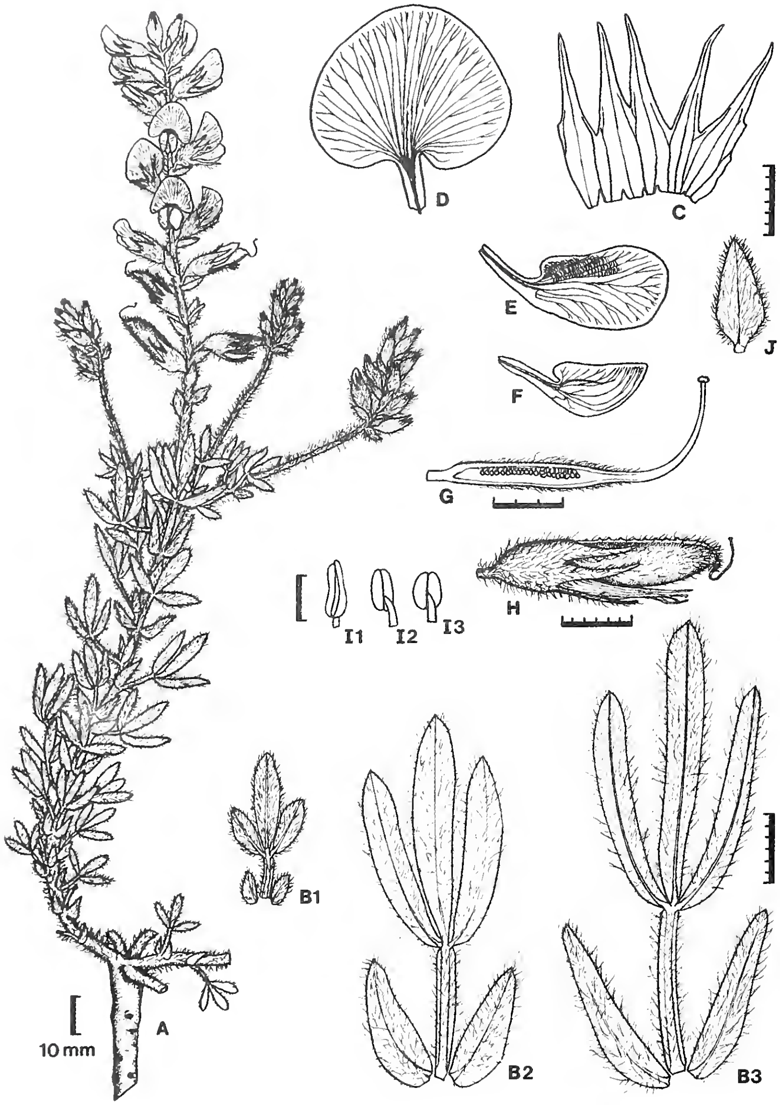

FIGURE 1.—*Lotononis racemiflora*. A, habit, showing a flowering branch, the persistant root and the long, racemose inflorescence. B1, B2, B3, leaves and stipules, showing the variation in size and shape and the pilose vestiture: B1, abaxial view of a mature leaf taken from a basal node, B2, adaxial view (note the vestiture), B3, abaxial view. C, calyx opened out, with the upper lobes to the left, vestiture not shown; D, standard petal; E, wing petal; F, keel petal, showing the small size and pointed apex; G, pistil; H, immature fruit in lateral view, showing the verrucose upper suture; I1, I2, I3, long anther, carinal anther and short anther respectively; J, bract. All from *Acocks 15171*. Scales in mm.

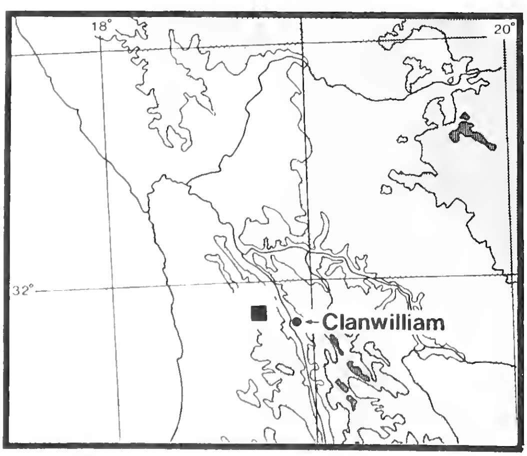

FIGURE 2.—The known geographical distribution of *Lotononis racemiflora*.

The new species may be confused with *L. angustifolia* and *L. involucrata* when not in flower, but the inflorescence structure is quite different. It is known from a single collection near Clanwilliam in the north-western Cape, where it was found on an old land in Fynbos-Strandveld vegetation. Figure 2.

CAPE.—3218 (Clanwilliam): Clanwilliam District, Bokwater, W of Clanwilliam (–BB), 28.10.1948, *Acocks 15171* (PRE, holo.; K. iso.).

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I wish to thank Dr H. F. Glen (Botanical Research Institute, Pretoria) for the Latin translation. The taxonomic study of *Lotononis* is a registered Ph. D. project at the University of Cape Town.

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DÜMMER, R. A. 1913. A synopsis of the species of *Lotononis*, Eckl. & Zeyh., and *Pleiospora* Harv. *Transactions of the Royal Society of South Africa* 3: 275–335.

Bothalia 19,1: 9–16 (1989)

Studies in the genus *Riccia* (Marchantiales) from southern Africa. 11. *Riccia montana* and *R. alboporosa,* a further two new white-scaled species of the group 'Squamatae'

S. M. PEROLD*

Keywords: air pores, anatomy, calcium salts, distribution, endemic, rare, reticulation, scales, spore ornamentation

ABSTRACT

Another two new endemic species of the subgenus *Riccia*, section *Riccia*, group 'Squamatae', are described: *R.* **montana** and *R.* **alboporosa.** The distribution of *R.* **montana** is apparently restricted to high altitudes in the Drakensberg and Witteberg Mountain ranges. The species is characterized by ligulate branches, finely spongy dorsal surface and hyaline to white, calcium-encrusted scales. *R.* **alboporosa** is found in Namaqualand, but it is rare. It can be recognized by the distinctly porous appearance of the dorsal surface due to the presence of large, ± regularly spaced air pores, which are encircled by six or seven radially arranged, wedge-shaped cells that become white on drying, hence the specific epithet.

UITTREKSEL

Nog twee nuwe endemiese spesies van die subgenus *Riccia*, seksie *Riccia*, groep 'Squamatae', word beskryf: *R.* **montana** en *R.* **alboporosa.** Die verspreiding van *R.* **montana** is blykbaar beperk tot hooggeleë gebiede in die Drakensberg- en Witteberggebiede. Die spesie word gekenmerk deur lintvormige vertakkings, fyn, sponserige dorsale oppervlak en hialiene tot wit, kalkbedekte skubbe. *R.* **alboporosa** kom voor in Namakwaland maar dit is skaars. Dit kan erken word aan die duidelik poreuse voorkoms van die dorsale oppervlak, veroorsaak deur groot, ± reëlmatig verspreide lugporieë wat omsluit word deur 'n ring van ses of sewe radiaal gerangskikte, wig-vormige selle wat wit word met uitdroging, vandaar die spesifieke epiteton.

1. **Riccia montana** *Perold,* sp. nov.

Thallus dioicus, perennis; subviridis vel viridis, in sicco albidus vel flavidus; subtiliter spongiosus; marginibus reflexis vel inflexis saepe labia duo secus ramos formantibus. *Frons* usque ad 8 mm longa, (1,5–) 1,7–2,0 (–2,5) mm lata, 0,6–0,75 mm crassa, 2,5–3-plo latiora quam crassa, lobis ligulatis, dorsaliter profunde sulcatis. *Squamae* apicem versus undulatae, mox ad latera appressae, vix margines thalli superantes, hyalinae vel calcii depositis tectae. *Sporae* 70,0–85,0 μm diametro, alis ± 5 μm latis, grosse reticulatae, 7–8 areolis trans diametrum, parietibus areolarum crassis. *Chromosomatum numerus* n = 9.

TYPE.—Cape Province, 3027 (Lady Grey): Witteberg Mountains, basalt cliffs at top of Jouberts Pass, 10 km E of Lady Grey, eastern aspect, alpine heath-grassland (–CB), *Van Rooy 2712* (PRE, holo.), with *Bryum alpinum* Huds. ex With.

Thallus dioicous (Figure 1A, B), perennial, gregarious, not in rosettes, medium-sized; branches apically symmetrically or asymmetrically furcate, frequently with short lateral branching more proximally, medium to widely divergent, up to 8 mm long, segments 3–5 mm long, (1,5–)1,7–2,0(–2,5) mm wide, 0,6–0,75 mm thick, i.e. ± 2½ to 3 times wider than thick, ligulate, apex rounded to subacute, emarginate, deeply grooved on dorsal surface (Figure 2A), proximally ± flat to slightly concave (Figure 1D1–6); dorsally light green to green, finely spongy and glistening; margins acute, flanks almost vertical distally to sloping somewhat obliquely outward and upward proximally, green; ventral surface rounded, green; when dry, dorsally white to yellowish, margins inflexed or more usually reflexed along the edges (Figure 1C), generally forming two lips in proximal parts of branches. *Anatomy:* dorsal epithelium unistratose, hyaline, bulging upper walls of cells covered with fine deposit of calcium salts (Figure 2C), 20–30 × 35×50 μm, cell width somewhat irregular, sometimes single cells spanning 1½–2(–3) subdorsal cells (Figure 1E), soon collapsing; air pores often only partly aligned with air canals below (Figures 1F, 2C), large, 20–45 μm across, wider towards thallus margins, (3–) 4–5(–6)-sided (Figure 2D); assimilation tissue (chlorenchyma) consisting of vertical columns of 6–10 cells, ± 50–65 × (37–)42–50 μm, air canals in between assimilation cell columns ± 50 (–65) μm wide (Figure 1E, G); storage tissue occupying lower ½ or more of the thickness of thallus, cells tightly packed. Rhizoids hyaline, some smooth, others tuberculate, up to 25 μm wide, arising from ventral epidermis of thallus and base of scales. *Scales* wavy at apex, soon appressed to flanks, imbricate, hyaline or whitened with calcium deposits, sometimes flecked with red toward base, hardly exceeding thallus margins (Figures 1H; 2B), 850 × 500 μm, cells in body of scale 4–6-sided, 50–85(–90) × ± 40 μm, smaller at margin, ± 30 × 50 μm, cell walls mostly bulging. *Antheridia* with hyaline or white necks ± 160 μm long, projecting from small, shallow pits on either side of dorsal groove (Figure 1A). *Archegonia* purple-necked, scattered along groove in female plants. *Sporangia* proximal, single or 2 adjacent, each containing about 450 spores, large, ± 750 μm wide, bulging conspicuously dorsally (Figure 1B), overlying thal-

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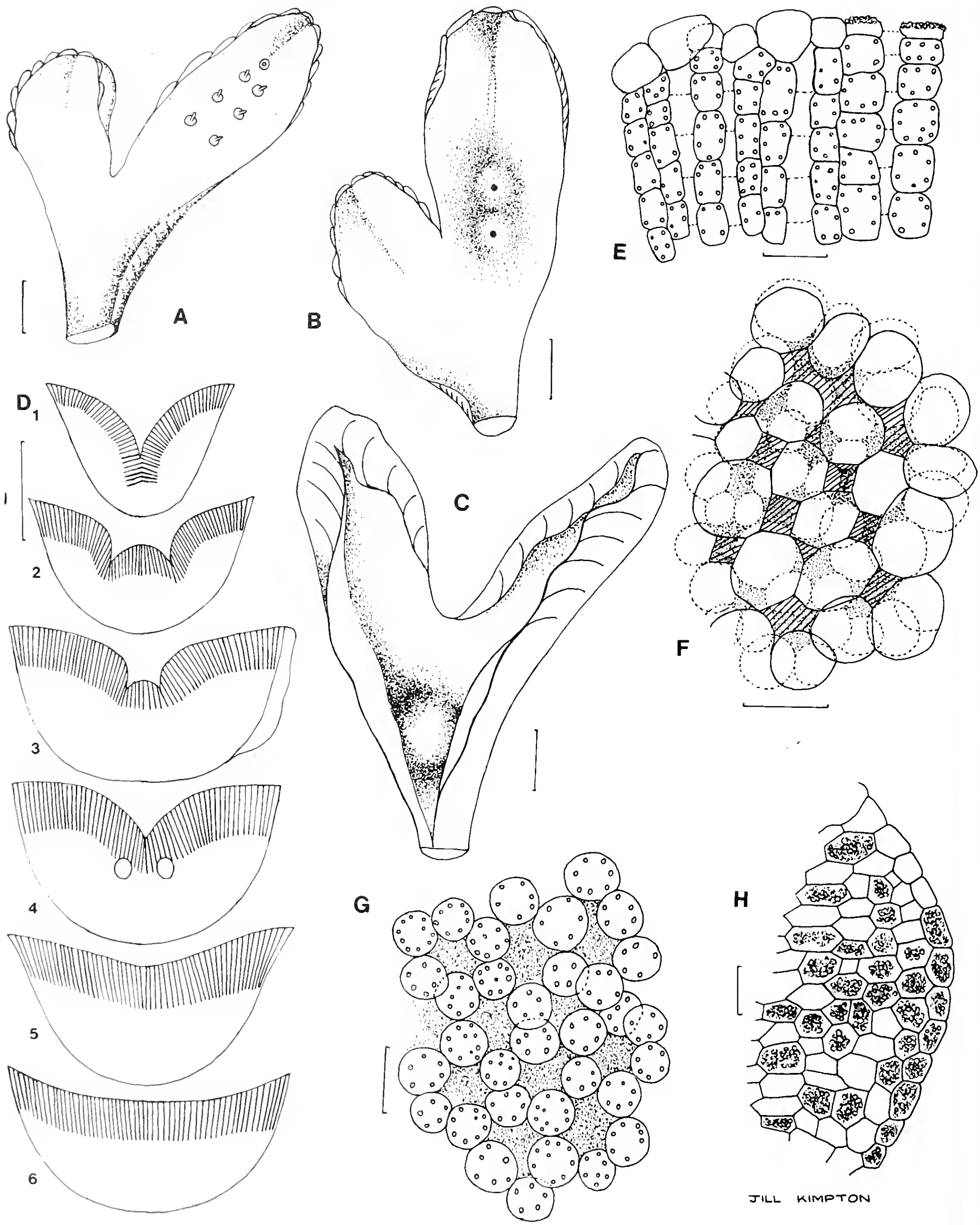

FIGURE 1.—*Riccia montana*. Structure of thallus and scales. A, fresh male thallus; B, fresh female thallus with sporangia; C, dry female thallus; D1–6, transverse sections of thallus branch at different distances from apex to basal parts; E, transverse section through dorsal epithelium and chlorenchyma; F, epithelial cells (solid lines), and air pores (hatched lines) from above, with subdorsal cells (broken lines) and air canals (stippled); G, horizontal section through chlorenchyma, with air canals stippled; H, scale. A–C, *Van Rooy 3046*; D1–6, *Van Rooy 2712*; E, *Oliver 8354*; F, G, *Perold 31*; H, *Van Rooy 2718*. A–H drawn by J. Kimpton. Scale bar on A–D = 1 mm; E–G = 50 μm; H = 100 μm.

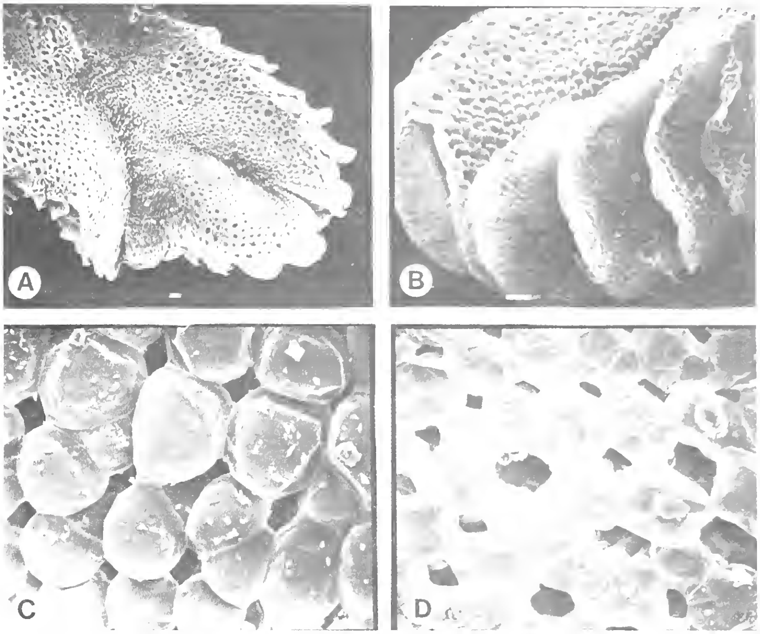

FIGURE 2.—*Riccia montana*. Structure of thallus and cells. A, dorsal view of thallus, apically grooved; B, scales at apical margin; C, intact dorsal cells with calcium deposits, air pores; C, collapsed dorsal cells with wide air pores. A–D, *Oliver 8354*, SEM micrographs. Scale bar = 50 μm. All SEM and LM micrographs by S. M. Perold.

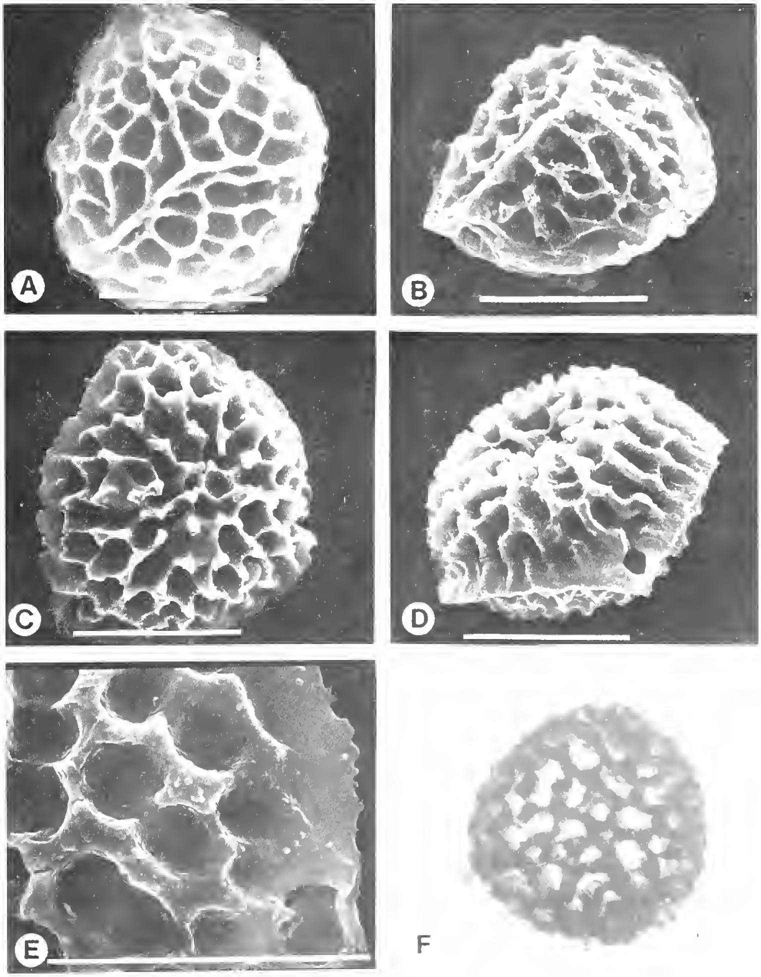

FIGURE 3.—*Riccia montana*. Spores. A, proximal face; B, proximal face viewed from side; C, distal face; D, distal face, side view; E, areolae, wing and pore on distal face, much enlarged; F, distal face. A, C, D, F, *Van Rooy 2712*; B, *Glen 1728*; E, *Van Rooy 2718*. A–E, SEM micrographs; F, LM micrograph. Scale bar = 50 μm; diameter of spore on F = ± 100 μm.

lus tissue not turning white, but shrinking and disintegrating. *Spores* (70,0−)75,0−80,0(−85,0) µm in diameter, brown, semi-transparent, triangular-globular, polar, wing ± 5 µm wide, wider at perforated angles, margin somewhat wavy (Figure 3A, C), finely eroded, crenulate, ornamentation on both faces completely or incompletely coarsely reticulate; distal face with 7 or 8 rounded to angular areolae across diameter, ± 7,5 µm wide (Figure 3C, F), walls thick and high, ± 5 µm tall, extending partly onto wing, with raised papillae at areolar nodes; proximal face with triradiate mark distinct to less clearly defined, areolae often incomplete, irregularly ridged (Figure 3B), or with complete, angular areolae, raised at nodes (Figure 3A). *Chromosome number* n = 9 (T. Bornefeld pers. comm.).

Riccia montana grows on black, humus-rich soil, overlying rocky outcrops, often near seepages, and in association with moss species e.g. *Bryum alpinum* Huds. ex With. and with other *Riccia* spp.

In the white-scaled species of the group 'Squamatae', section *Riccia*, subgenus *Riccia*, *R. montana* and *R. argenteolimbata* (Volk *et al*. 1988) are the only two dioicous species. *R. montana* differs from the other *Riccia* species in this group by the finely spongy texture of the dorsal surface of the thallus, by the ligulate branches with lip-like, reflexed margins along the proximal parts when dry, by the coarsely reticulate, polar spores and by its distribution which is restricted to the eastern mountain ranges. It is somewhat similar to the other white-scaled species, *R. albolimbata* S. Arnell, *R. albornata* Volk & Perold, *R. argenteolimbata* Volk & Perold, and *R. alboporosa* sp. nov. in the group 'Squamatae', but it never turns chalk-white over the sporangia as does *R. albolimbata*. *R. albolimbata* and *R. albornata* generally have much larger, wavy, hyaline (or white) scales that extend above the thallus margins and broad, not ligulate branches. The ornamentation of their spores is also markedly different. *R. argenteolimbata* Volk & Perold, has a more compact thallus, stiff white scales and apolar spores, whereas *R. alboporosa* has a more coarsely spongy thallus, is dorsally puffy when dry and thickly covered with calcium salts, has inconspicuous scales and more finely reticulate polar spores. *R. montana* was originally recognized as a new species by the late Prof. E. A. C. L. E. Schelpe of BOL, from one of his gatherings at the Sentinel, Drakensberg in 1946. Unfortunately the spores were not fully mature, but recently, more collections of the same species with mature sporangia have been made, also in mountainous regions 2 000−3 000 m above sea level.

The specific epithet, *montana*, refers to the mountainous localities, where all the collections have so far been made. Its distribution area does not appear to overlap with that of any of the other white-scaled species, being confined to high altitudes in the Drakensberg of Natal and Lesotho and the Witteberg Mountains of the north-eastern Cape Province (Figure 4).

SPECIMENS EXAMINED

NATAL.—2828 (Bethlehem): Drakensberg, Sentinel, 9 500 ft (−CB), *Schelpe s.n.* (BOL).

LESOTHO.—2828 (Bethlehem): 6 km from Oxbow Lodge to Mokhotlong, basalt outcrops (−DC), *Van Rooy 3045, 3046* (PRE). 2927 (Maseru): Blue Mountain Pass, 19 km from Maseru on road to Thaba Tseka, calcrete soil on seepage bank (−BC), *J. M. Perold 31* (PRE). 2929 (Underberg): Sani River bank, ± 7 km from Sani Top, along road to Mokhotlong (−CA), *Van Rooy 3446* (PRE); Sani Top, mountain slopes W of Border Post (−CB), *Van Rooy, 3540, 3566* (PRE); Sani flats, 2 km from Sani Border Post to Mokhotlong (−CB), *Van Rooy 3702* (PRE); Sehlabathebe Nat. Park, on black gritty soil bordering stream, 2 300−2 500 m (−CC), *Jacot Guillarmod, Getliffe & Mzamane 60* (PRE).

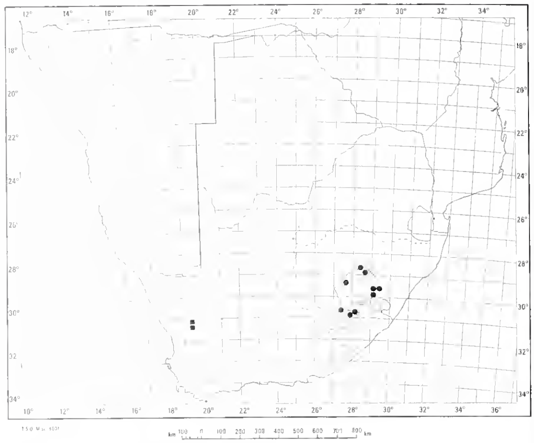

FIGURE 4.—Map showing distribution of *R. montana*, ● and *R. alboporosa*, ■ in southern Africa.

CAPE.—3027 (Lady Grey): Witteberg Mountains, basalt cliffs at top of Jouberts Pass, 10 km E of Lady Grey (−CB), *Van Rooy 2718* (PRE); ibid. *Van Rooy 2712* (see type); Ben MacDhui, above Rhodes, wet loamy plateau S of main peak, very short grassland (−DD), *Oliver 8354* (PRE). 3028 (Matatiel): 20 km from Rhodes, up Naudesnek towards Maclear (−CA/CC), *Glen 1728* (PRE).

2. **Riccia alboporosa** *Perold*, sp. nov.

Thallus monoicus, perennis, in vivo flavido-viridis, dense calcii depositis tectus, poribus magnis regularibus; in sicco albidus, inflatus, marginibus solum apicaliter inflexis. *Frons* usque ad 7,0 mm longa, 1,8−3,5(−4,0) mm lata, 0,8−1,2 mm crassa, 2−3-plo latior quam crassa, obtuse cuneata vel late ovata, sulco dorsali lato. *Squamae* inconspicuae, aegre ad margines thalli extensae, calcio tectae. *Sporae* 75,0−88,0 µm diametro, polares, ala ± 5 µm lata, tenue reticulata, 11−13 areolis trans diametrum superficiei distalis. *Chromosomatum numerus* n = 10.

TYPE.—Cape Province, 3119 (Calvinia): NE of Nieuwoudtville, Groothoek, at Soetlandsfontein River (−AD), *Oliver 8854* (PRE, holo.), on sandy/clay flats alongside river, in rock crevices and on ledges, associated with *Riccia albornata* Volk & Perold and small moss species, *Bryum argenteum* Hedw.

Thallus monoicous, perennial, gregarious or single, not in rosettes; once (Figure 5A) or twice symmetrically or occasionally asymmetrically furcate (Figure 5B), branches medium to widely divergent, bluntly wedge-shaped to broadly ovate (Figure 6A), up to 7 mm long, 1,8−3,5 (−4,0) mm wide and 0,8−1,2 mm thick, i.e. 2−3 times wider than thick; apex rounded, emarginate; dorsally bright yellowish green with ± regularly spaced, large, conspicuous air pores encircled by lighter coloured cells; apically deeply grooved by wide sulcus (Figure 6B), proximally somewhat concave to nearly flat (Figure 5D1−5); ventrally green, gently rounded; flanks

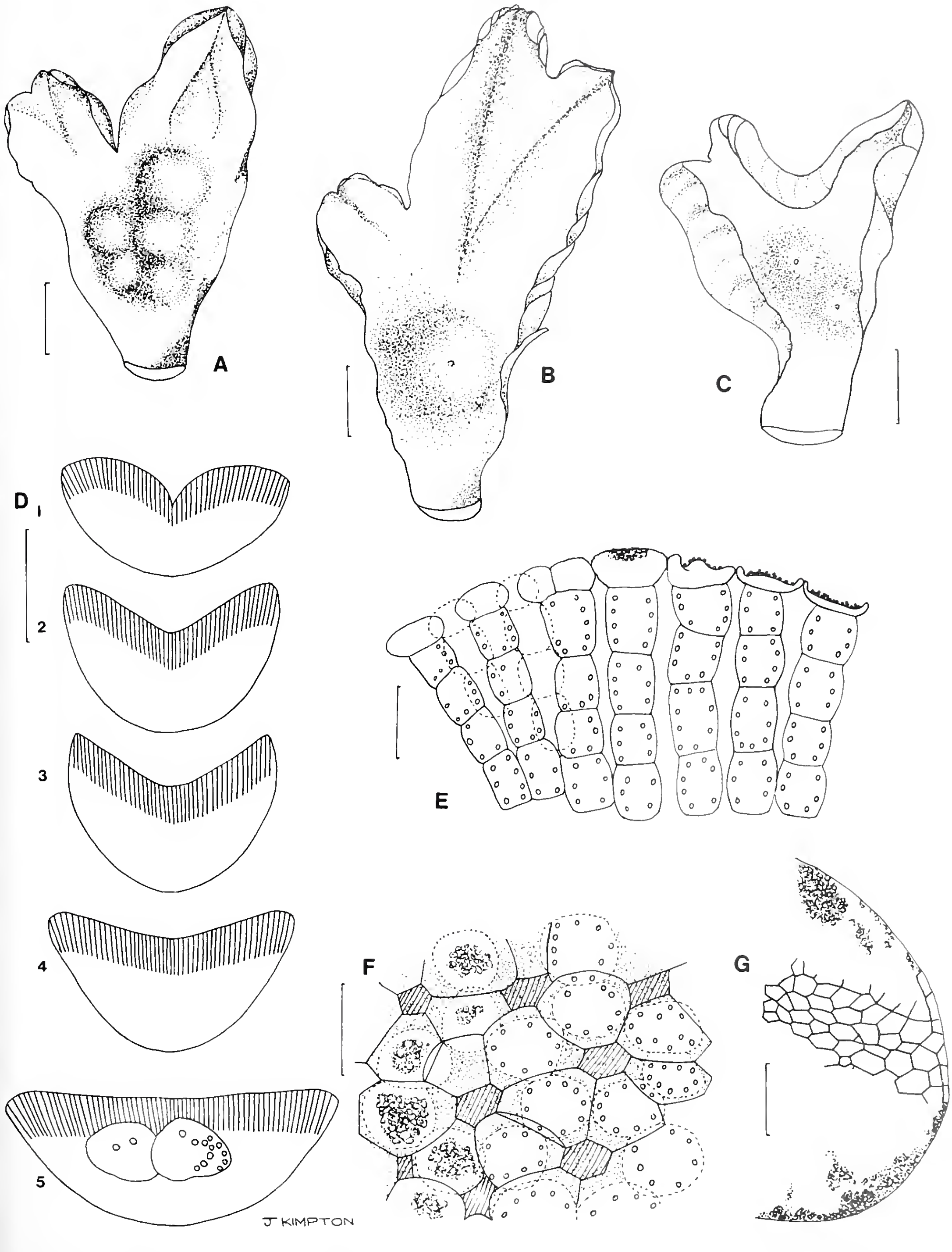

FIGURE 5.—*Riccia alboporosa*. Structure of thallus and scales. A, B, fresh thalli; C, dry thallus; D1–5, transverse sections of thallus branch at different distances from apex to basal parts; E, transverse section through dorsal epithelium and chlorenchyma; F, epithelial cells (solid lines) and air pores (hatched) from above, with subdorsal cells (broken lines) and air canals (stippled); G, scale. A, B, E, *S. M. Perold 1775*; C, D, E, G, *Oliver 8854*. A–G drawn by J. Kimpton. Scale bar on A–D = 1 mm; E, F, = 50 μm; G = 100 μm.

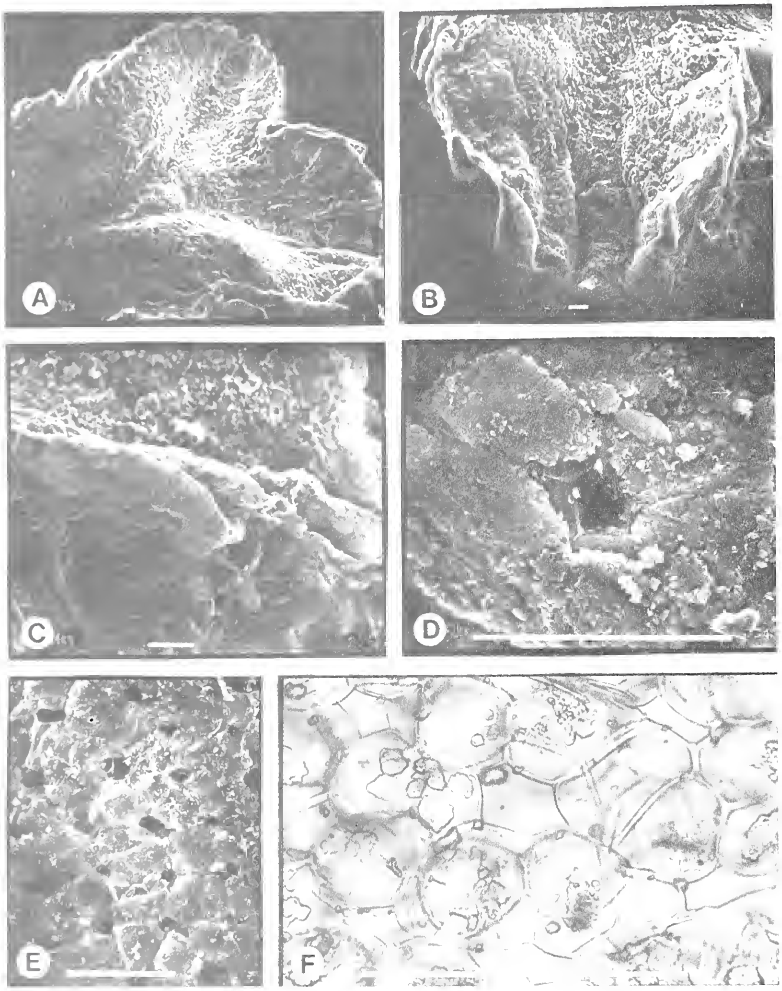

FIGURE 6.—*Riccia alboporosa*. Structure of thallus and cells. A, dorsal view of thallus; B, wide dorsal groove at apex; C, scales near apex; D, air pore with surrounding cells heavily encrusted with calcium crystals; E, air pores and dorsal cells; F, dorsal cells (lightly dusted with calcium crystals) encircling air pores, air canals and subdorsal cells faintly visible beneath. A–C, E, *S. M. Perold 1775*; D, F, *Oliver 8854*. A–E, SEM micrographs; F, LM micrograph. Scale bar = 50 μm.

sloping obliquely outward and upward to raised blunt margins (Figure 5D1–4); when dry, greenish white to white, somewhat puffy, slightly concave, margins erect to inflexed (Figure 5C) or apically clasped together, revealing regular white, appressed ventral scales. *Anatomy:* dorsal epithelium unistratose, cells hyaline, upper walls rounded near and in dorsal groove, but more laterally soon collapsing (Figure 5E) and becoming heavily encrusted with thick layer of calcium salts (Figure 6D), generally 6 or 7 cells wedge-shaped from above, 60–75 μm long ± 50 μm wide at broadest part, radially arranged around each air pore (Figures 5F; 6E, F), which leads to wider air canal below; assimilation tissue (chlorenchyma) on section occupying about ½ the thickness of the thallus, ± 400 μm thick, topmost cells generally somewhat thicker-walled, 20–25(–35) × 30–35 μm, often 2 under each dorsal cell, soon losing their chloroplasts as overlying cell layer collapses; air canals 50–80 μm wide (Figure 5D), enclosed by columns of rectangular cells ± 50 × 37–45 μm; storage tissue occupying lower ½ of thickness of thallus, cells 50–75 μm wide. Rhizoids hyaline, some smooth, others tuberculate, up to ± 25 μm wide, very long, arising from ventral epidermal cells and base of scales. *Scales* mostly inconspicuous, 550 × 350 μm, hardly extending to thallus margins, appressed, imbricate (Figure 6C), rounded, smooth-edged, heavily encrusted with calcium salts, especially on exposed distal parts of scales, cells mostly 6-sided in body of scale, ± 85 × 37 μm (Figure 5G), marginally smaller, brick-shaped. *Antheridia* with hyaline necks, scattered along groove. *Archegonia* with purple necks. *Sporangia* single near base (Figure 5B), or crowded in groups along middle of branch (Figure 5A), bulging dorsally, ± 800 μm wide, containing ± 400–500 spores. *Spores* (75,0) 80,0–85,0 (–88,0) μm in diameter, yellow-brown, semi-transparent, triangular-globular, polar (Figure 7A, E), wing ± 5 μm wide, slightly wider at perforated angles, margin mostly smooth; ornamentation reticulate: distal face with 11–13 areolae across diameter (Figure 7B, C, F), ± 5 μm wide, toward centre somewhat larger and with thicker, higher walls, ridges extending onto wing, radial ones generally more pronounced than those across (Figure 7D), slightly raised at nodes; proximal face with triradiate mark ± distinct (Figure 7A, E), each facet with up to ± 50 small, round areolae ± 3 μm wide, some adjacent ones confluent, ridges low (Figure 7A, E). *Chromosome number* n = 10 (Bornefeld pers. comm.).

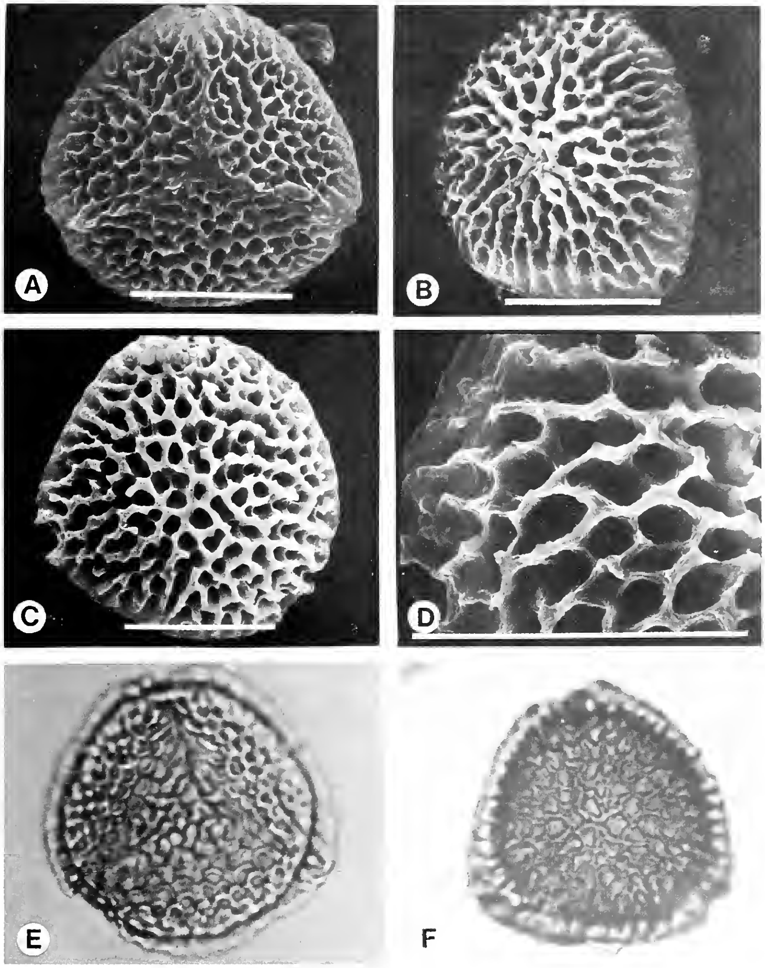

FIGURE 7.—*Riccia alboporosa*. Spores. A, E, proximal face; B, C, F, distal face; D, enlarged view of areolae and margin on distal face. A–F, *Oliver 8849*. A–D, SEM micrographs; E, F, LM micrographs. Scale bar = 50 μm; diameter of spore on E, F = ± 100 μm.

Riccia alboporosa is known from only two localities in the drier area of the north-west Cape Province, with an annual winter rainfall of less than 200 mm at altitudes of 750–850 m above sea level. It grows on fine yellow-brown, sandy or slightly brackish soil overlying tillite rocks, in association with other *Riccia* species, e.g. *R. albornata* Volk & Perold and with the small moss species *Bryum argenteum* Hedw. and with *Aloina bifrons* (De Not.) Delgadillo.

It is easily recognized by a feature alluded to in the specific epithet: the thallus has numerous large, widely but ± regularly spaced air pores encircled by dorsal epithelial cells, part of which form the roof over the air canals and on drying, rapidly become white, before the remainder of these cells, supported by subdorsal cells, do. The dorsal surface becomes heavily encrusted with calcium salts, which, in field-grown specimens, must be removed with dilute hydrochloric acid, before the cell outlines can be distinguished. As seen from above, each hyaline dorsal cell is in contact with an air pore, which necessitates placing this species in the subgenus *Riccia* (Volk 1983), although the air canals are wider than is generally encountered in this subgenus. It differs from the other white-scaled species by the inconspicuousness of its scales, by the puffy appearance of the dorsal surface in the dry plant and by the finely reticulated spores.

SPECIMENS EXAMINED

CAPE.—3119 (Calvinia): S of Loeriesfontein, Skietnes Kloof, E of Slagberg, rocky ledges, facing South (–AB), *Oliver 8849* (PRE); NE of Nieuwoudtville, Groothoek, at Soetlandsfontein River (–AD), *S. M. Perold 1772, 1775, 2317* (PRE).

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Bothalia 19,1: 17–25 (1989)

Studies in the genus *Riccia* (Marchantiales) from southern Africa. 12. *Riccia albolimbata* and the status of *R. albosquamata*, white-scaled species originally described by Arnell

S. M. PEROLD*

Keywords: Arnell, Marchantiales, *Riccia albolimbata*, *R. albosquamata*, white scales

ABSTRACT

Arnell's (1957, 1963) inadequate descriptions, poor drawings, mistakes in the text and key, as well as mixed collections, have all contributed to the confusion regarding the identity of his species *R. albolimbata* and *R. albosquamata*. Volk's collections (Arnell 1957) of the latter consist mostly of two white-scaled species in the same packet: one is *R. albolimbata* and the other is *R. argenteolimbata* Volk & Perold (Volk *et al.* 1988). Evidently Arnell used characters of both plants to describe *R. albosquamata*, although the type specimen, *Volk 452*, consists of only *R. albolimbata* (plus fragments of *R. atropurpurea* Sim and *R. trichocarpa* Howe). *R. albosquamata* is accordingly to be regarded as a taxonomic synonym of *R. albolimbata*.

UITTREKSEL

Arnell se (1957, 1963) onvoldoende beskrywings, swak tekeninge, foute in die teks en sleutel, sowel as gemengde versamelings, het almal bygedra tot die verwarring omtrent die identiteit van sy spesies *R. albolimbata* en *R. albosquamata*. Volk se versamelings (Arnell 1957) van laasgenoemde, bestaan meestal uit twee spesies met wit skubbe in dieselfde pakkie: die een is *R. albolimbata* en die ander een *R. argenteolimbata* Volk & Perold (Volk *et al.* 1988). Blykbaar het Arnell kenmerke van beide plante gebruik om *R. albosquamata* te beskryf, alhoewel die tipe-eksemplaar, *Volk 452*, alleenlik bestaan uit *R. albolimbata* (plus fragmente van *R. atropurpurea* Sim en *R. trichocarpa* Howe). *R. albosquamata* word derhalwe beskou as 'n taksonomiese sinoniem van *R. albolimbata*.

1. **Riccia albolimbata** *S. Arnell*, Mitteilungen aus der Botanischen Staatssammlung, München: 264 (1957); 1963: 25.

TYPE.—SWA/Namibia, 2117 (Windhoek): Farm Voigtland, bei Windhoek, gegen Ondekaremba, Kalkboden (–AB), 1956.02.12. *Volk 11419* (PRE-CH 4232) (M!, holo., PRE!). 2217 (Windhoek): Binsenheimkamp (–CD), *Volk 11080* (M!, PRE!, para.).

Thallus monoicous, perennial, in rosettes 15–20 mm across, or in crowded gregarious patches; medium-sized; furcate or bi-furcate, branches ± symmetrical or one branch smaller, diversely divergent, ovate to oblong, up to 8,0 mm long, (1,5–) 1,8–2,2 (–3,0) mm broad, 2–2,5 times wider than thick; apex rounded, emarginate (Figures 1A; 2A); sulcus narrow and deep distally, disappearing in proximal parts, which are ± flat or slightly concave (Figure 1D1–5); dorsally green and shiny, becoming white and spongy over sporangia; margins acute to subacute, flanks generally sloping obliquely upward and outward, green or brown to dark red; ventral surface flat to slightly rounded (Figure 1C, 1D1–5), green; when dry, margins inflexed with wavy hyaline/white scales covering most of dorsal surface (Figure 1B).

Anatomy of thallus: cells of dorsal epithelium emerging apically from groove in regular rows, hyaline, thin-walled, unistratose, dome-shaped or globose (Figures 1E; 2C), ± 45 × ± 50 μm, each cell usually with a single corresponding column of assimilation cells beneath, bulging upper walls sprinkled with calcium carbonate granules, cells soon collapsing, especially toward margins and more proximally (Figures 1E; 2D); air pores 4–5(–6)-angled, leading to air canals below (Figure 1F); assimilation tissue (chlorenchyma) about ½ the thickness of thallus, cells short -rectangular, ± 50 × 40–45 μm, in columns of 6–8 (–10), enclosing 4–5-sided air canals (Figures 1F; 2E) which widen toward sides of branches (Figure 2B); storage tissue occupying lower ½ of thallus, cells angular, size ± 55 μm. Rhizoids mostly smooth, some tuberculate, 15–20 μm wide. *Scales* hyaline to white, base often flecked with brown or dark red, closely imbricate, undulating, large, 800–900 (–1200) × ± 600 μm (Figure 1G), extending ± 150 μm above margin of thallus, rounded, edge mostly smooth, cells hexagonal to oblong-hexagonal in body of scale (Figures 1H; 2F), 55–100 × 35–55 μm, marginally smaller, ± 25–40 × 30–40 μm, surface of cells often encrusted with calcium carbonate deposits, cell walls generally free of crystals. *Antheridia* with thick hyaline necks becoming white and thread-like, in one or two rows along middle of lobe. *Archegonia* with purple necks. *Sporangia* with about 300–450 spores each, overlying tissue turning white and spongy, disintegrating soon and leaving several capsules exposed along the longitudinal hollow. *Spores* 82–95 (–105) μm in diameter, yellow-brown to dark brown, semi-transparent to opaque, triangular-globular, polar, with wing narrow, 3,0–5,0 μm wide, often with pores at marginal angles, margin crenulate or finely eroded (Figure 3A); distal face with ornamentation quite variable, generally (7–) 10–12 angular to round areolae across (Figure 3B, C, D), 5,0–7,5(–10,0) μm wide, areolar walls varying from thin to thick, with raised papillae at nodes (Figure

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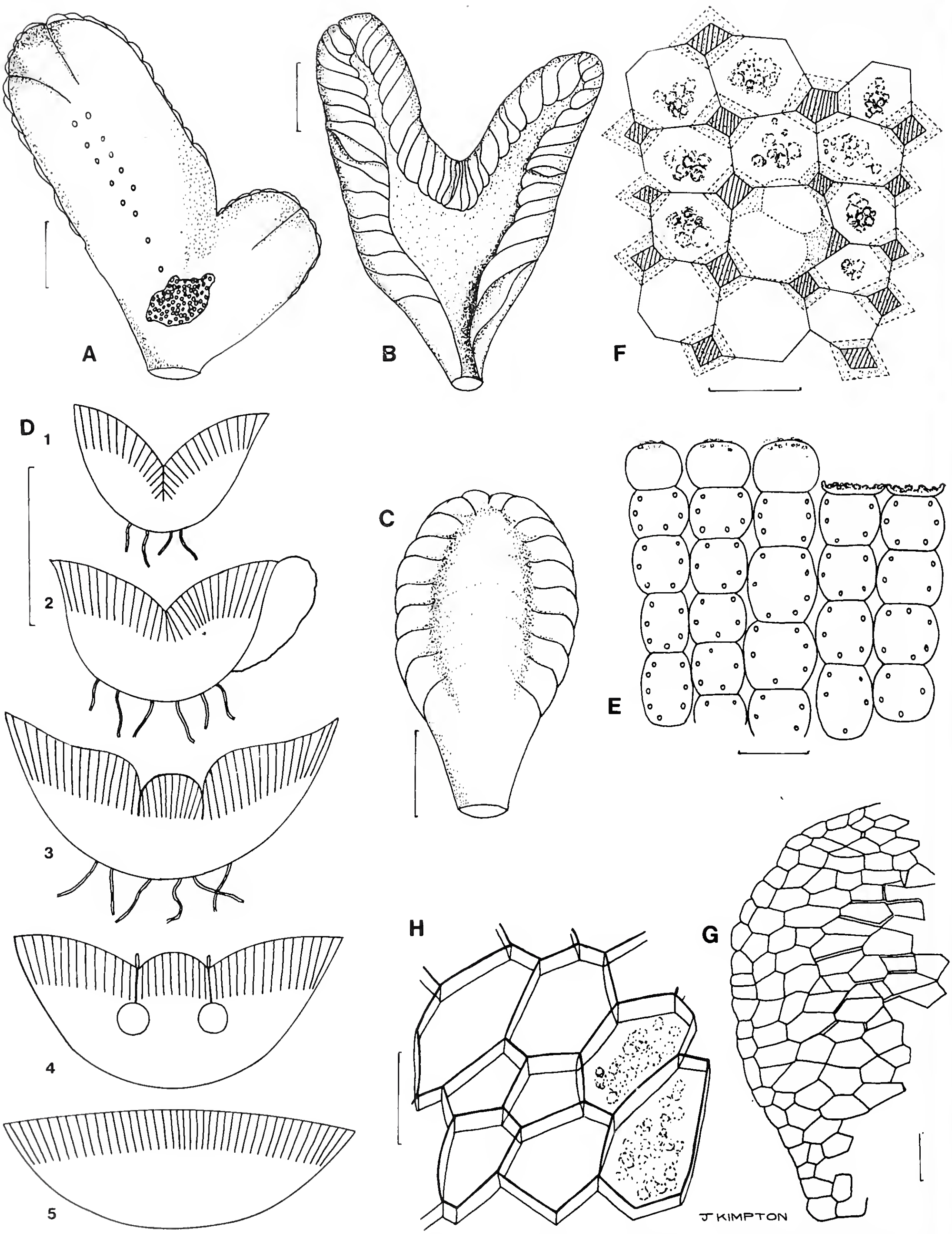

FIGURE 1.—*Riccia albolimbata* Arnell. Morphology and anatomy. A, fresh thallus; B, dry thallus; C, ventral view of thallus; D1–5, transverse sections of branch at different distances from the apex to older proximal part, *S. M. Perold 1380*; E, enlargement of transverse section through intact dorsal epithelial cells, capped with calcium crystals and showing narrow air canals in assimilation tissue; on right collapsed dorsal epithelial cells toward margin and larger air canals between columns of cells; F, epithelial cells with calcium crystals, air pores (hatched) overlying 4–5-sided air canals (dotted), as seen from above, *S. M. Perold 398*; G, scale; H, enlarged scale cells with calcium crystals, *S. M. Perold 803*. Drawings by J. Kimpton. Scale bar: A–D = 1 mm; E, F, H = 50 μm; G = 100 μm.

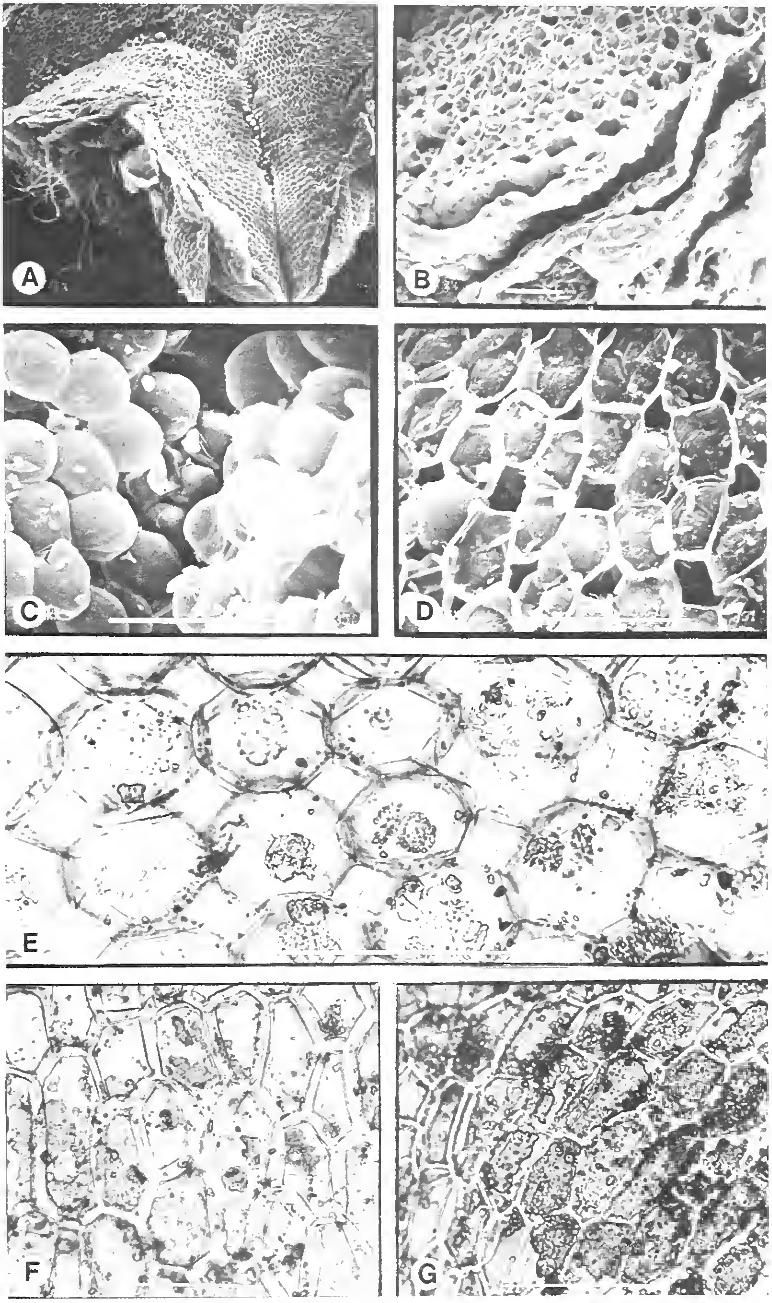

FIGURE 2.—*Riccia albolimbata* Arnell. Morphology and anatomy. A, dorsal view of apex and groove; B, large air pores near margin; C, globose dorsal cells intact at groove; D, collapsed dorsal cells around air pores; E, dorsal cells and air pores, *S. M. Perold 398*; F, scale cells, *Volk 11419*; G, scale cells, *Volk 452*. A–D, SEM micrographs; E–G, LM (light microscope) micrographs. Scale bar on A–G = 100 μm. All SEM and LM micrographs by S. M. Perold.

3F), frequently only a few of the areolae over central area complete, and short, irregular ridges radiating outwards from central areolae and extending onto wing; proximal face with triradiate mark distinct and generally incompletely areolate, walls often thinning out or anastomosing to form irregularly branching ridges (Figure 3A, E). *Chromosome number* n = 12 (*Volk 81/204* p.p.); 16 *(Volk 81/160)*; *(Volk 81/231b* as *R. albosquamata)*; 24 *(Volk 81/164)* (Bornefeld 1984).

Different chromosome patterns within the same *Riccia* species, due to differential multiplication of individual chromosomes, were reported by Bornefeld (1984) and termed 'nothopolyploidy'. Multiple chromosome numbers in some species (such as *R. albolimbata*) render chromosome numbers unsuitable as a diagnostic character (Volk *et al.* 1988).

R. albolimbata is widely distributed in the summer rainfall area of southern Africa and has been collected in South West Africa/Namibia and in Transvaal, Orange Free State and north-eastern Cape Province. It is apparently quite rare in Natal and central Cape and has not been found in the winter rainfall area of the northwestern, western and south-western Cape (Figure 5).

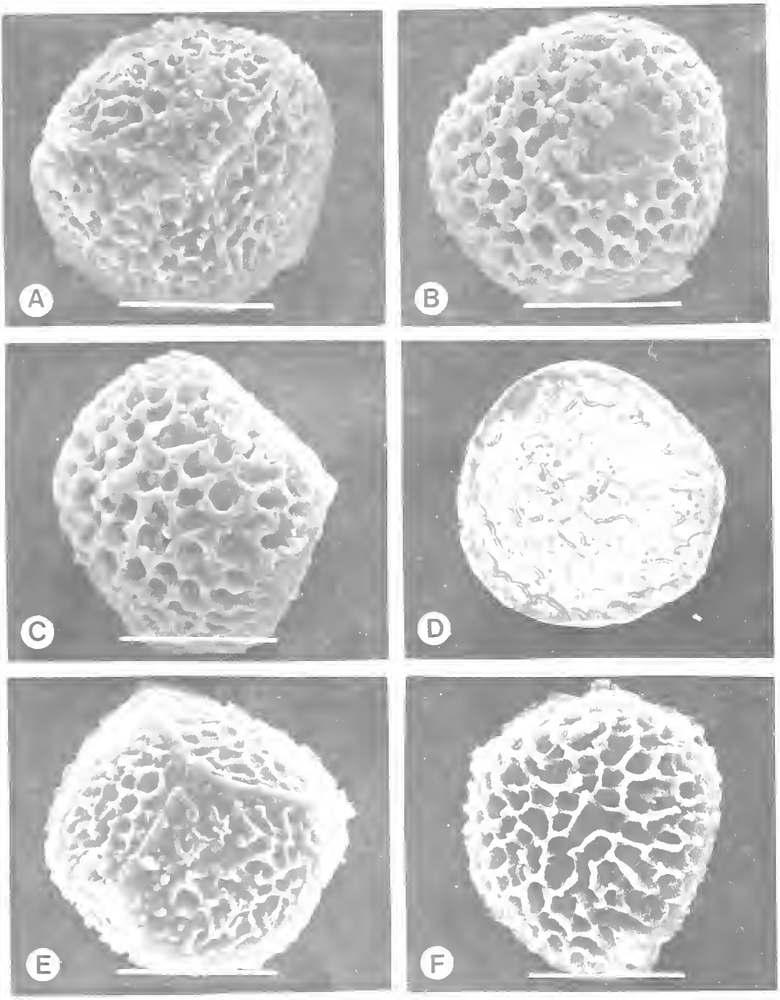

FIGURE 3.—*Riccia albolimbata* Arnell. Spores. A, proximal face; B, distal face; C, side view of distal face; D, distal face, *Volk 11419*, holotype, (spores from disintegrated sporangium at base of thallus); E, proximal face; F, distal face, *Volk 11080*, paratype. A–C, E, F, SEM micrographs; D, LM (light microscope) micrograph. Scale bar on A–C, E, F = 50 μm; diameter of spore on D, ± 100 μm.

It often grows on rocky outcrops, on shallow, calcrete soil at an alkaline pH, and on loamy soil between tufts of grass, sometimes in association with other *Riccia* species, e.g. *R. atropurpurea* Sim, *R. okahandjana* S. Arnell, *R. trichocarpa* Howe, *R. argenteolimbata* Volk & Perold and rarely with *Marchantia* spp.

Arnell (1957, 1963) reported *R. albolimbata* to be dioicous, but it is definitely monoicous (Table 1). There are other inaccuracies in his description as well: with branches 7 × 2 mm, it is not truly 'minor', but medium-sized; the dorsal colour of the thallus is green when fresh, not 'pale green'; the scale cells are not 'almost quadratic', except occasionally at the margins: in the body of the scale they are oblong-hexagonal (he also described the cell shape as 'generally hexagonal' (Arnell 1957, at the bottom of p. 266), mistakenly referring to it as *R. albomarginata*, as explained below), and their cell sizes at 55–100 × 35–55 μm are usually somewhat larger than the 30 × 30–40 × 60 μm he reported; the scale cell walls are hardly thinner than in *R. albosquamata* [in both, the vertical walls are frequently visible (Figures 1 G, H and 2F, G which illustrate only *R. albolimbata*)]. The surfaces of the scale cells are often encrusted with calcium carbonate, but he did not mention it, only referring to it under *R. albosquamata*. In *R. albolimbata* spores, he described the wing as incomplete, but it could have been partly folded inwards or partly obscured, as his illustrations (Arnell 1957, Figure 2; 1963, Figure 14) suggest. Although there are generally papillae arising from the areolar nodes, he stated that they were without papillae; his illustrations show ± 12 areolae across the distal face, but it has been found that the ornamentation shows a good deal of variability, with the areolae often incompletely separated, and hence fewer in number (Table 2). The inner face, however, clearly has 'irregular, thin lamellae' as described by him.

In his key to the *Riccia* species (pp. 13–16), *R. albolimbata* has been left out and *R. albomarginata* is listed twice, at Nos 7 and 11. On p. 14, at No. 11, *R. albomarginata* must be replaced by *R. albolimbata*, and also on p. 25, as he is comparing *R. albosquamata* with *R. albolimbata* (and not with *R. albomarginata*!). In the couplet (i) and (ii) on p. 14, part of the first sentence must be transposed, to correspond with his information in the *text*, viz. 'with a deep and sharp furrow' belongs with the information about *R. albolimbata* and 'slightly concave' refers to his description of the dorsal surface of

TABLE 1.—Comparison of Arnell's data on *Riccia albolimbata* and *R. albosquamata*. Observations and/or comments on type and other specimens by author

	R. albolimbata		*R. albosquamata*	
	Arnell	Perold	Arnell	Perold
Substrate		Brown soil		Finely textured, gray soil with calcium content ±5 times higher than that of *Volk 11419* (LINK X-ray Microanalysis)
Sex	Dioicous	Monoicous	Monoicous	Monoicous
Colour	Pale green, shiny when fresh; colourless and 'spongious' over archegonia	Dry specimens white	White, shiny when fresh	White
Size	7 × 2 mm	Up to ±7 mm long, 1,6–1,8 mm wide, 0,9 mm thick	5 mm long	Up to 5 mm long, segments 3 mm long, 1,3(–1,6) mm wide, 0,9 mm thick
Width: thickness	2–3 times broader than thick	1,6–2 times broader than thick	3 times broader than thick	1,4–1,6 times broader than thick
Branching	Bifurcate	Bifurcate	Dichotomously branching, with one branch longer	Bifurcate
Segment shape	Ovate	Broadly ovate		
Apex	Subacute	Rounded		
Groove	Deep and sharp, except proximally plano-convex, lateral parts of dorsal surface convex	Deep and sharp apically, concave proximally	Slightly concave dorsally	Apically grooved, proximally concave, frequently with ± bulging sporangia
Margin	Subacute	Acute to subacute	Sharp, thin and scale-like	Could not be verified
Flanks	Obliquely ascending at 45–60°	Steep in old, long dried herbarium specimens, mostly oblique when fresh but degree possibly somewhat affected by shade and moisture conditions	Perpendicular, almost straight in upper $^2/_3$, arched in ventral $^1/_3$	Presumably referring to *R. argenteolimbata*
Epithelium	Cells thin-walled, upper wall subspherical	Collapsed, except in groove at apex	Thin-walled, ± cubic, 20 μm, soon destroyed	Presumably referring to *R. argenteolimbata*
Scales	Large, exceeding margin of thallus, entire, rounded, imbricate, cells thin-walled, almost quadratic, 30 × 30 to 40 × 60 μm	1 200 × 700 μm, cells in body of scale hexagonal, up to 100 × ±35 μm, wavy, hyaline; in other specimens white with calcium deposits	Large, imbricate, white with pale purple base, widely exceeding margin of thallus, margin entire, rounded, like scales of *R. limbata*, cells large, 50 × 70 μm, thick-walled, lumen ± filled of (sic) fine granules	Presumably referring to *R. argenteolimbata*; scales in *Volk 452*, 850–1 000 × 550 μm, cells oblong-hexagonal, 60–75 × 37 μm, not thicker-walled, white, heavily encrusted with overlying calcium deposits, perhaps due to much higher calcium content in substrate
Spores				
Diameter	80–100 μm	(See Table 2)	70–80 μm	(See Table 2)
Colour	Brown	Yellow-brown to dark brown	Dark brown	Yellow-brown to nearly black
Wing	Incomplete	Partly folded or obscured	2–4 μm	5–7,5 μm
Outer face	Foveolae 8–10 μm wide, rounded, without papillae, thin reticulum	±12 areolae across distal face, as illustrated in drawing by Arnell (variable)	Irregularly areolate, 7–8 areolae in diameter, (8–)10–12 μm wide, 'processes of reticulum as spines in the wing'	Areolae frequently incompletely separated and hence fewer in number
Inner face	Irregular, thin lamellae	Irregular, thin lamellae	Not described or illustrated	Irregular thin lamellae

TABLE 2.—Comparison of measurements of spores from the type specimens of *Riccia albolimbata* (*Volk 11419*) and *R. albosquamata* (*Volk 452*: only the white-scaled portions). A minimum of 10 spores examined from each sporangium

	Spore diameter in μm	No. of areolae across distal face	Areolar width in μm	Wing width in μm
R. albolimbata (*Volk 11419*)				
1. Disintegrated sporangium at base of thallus	87–92	9–12	5,0–7,5	3,0–5,0
2. Disintegrated sporangium beneath thallus	92–95	7–9	7,5–12,0	5,0
3. Disintegrated sporangium in soil	82–95	8,9	7,5–10,0	5,0
R. albosquamata (*Volk 452*)				
1. Sporangium in small thallus	77–90	8–10	7,5–10,0	5,0–7,0
2. Sporangium in larger thallus	85–100	8–19	7,5–12,5	7,0
3. Sporangium ± midway along length of lobe	70–90	9,10	5,0–10,0	3,0–5,0
4. Sporangium at base of thallus	75–90	10–12	5,0–7,5	5,0–7,0
5. Sporangium in small, loose thallus (yellow-brown spores)	95–100	10–12	7,5–10,0	7,5
6. Small sporangium (black, ± poorly preserved spores)	77–80	±10	±5,0–7,0	5,0

R. albosquamata. It has now, however, become clear that the dorsal surface of *R. albolimbata* is only apically deeply grooved, and flat to somewhat concave proximally, whereas that of the other white-scaled species in these Volk collections, *R. argenteolimbata* (Volk *et al.* 1988), is deeply grooved along the entire length of the thallus.

Besides the types, there are fortunately several other fairly good specimens of *R. albolimbata* with spores [*Volk 11080* (M!, PRE!), *11401* (M!), *11705* (PRE!) and 11946 (M!, PRE!)], identified by Arnell, to enable one to form a clear concept of the characters of this species. *Volk 11967* (PRE!), is possibly a large plant of *R. atropurpurea*, judging by the spore ornamentation, but the thalli are broken up and it is difficult to make a definite decision about its identity. In notes found with some of Duthie's collections from Fauresmith and Middelburg (Cape) and now identified as *R. albolimbata*, she referred to them as the 'Doornberg' species, thus clearly indicating that she recognized them as belonging to a distinct species. Regrettably, she made no attempt to describe it.

R. albolimbata is closely similar to *R. albornata* Volk & Perold (Volk *et al.* 1988), but the former often grows in rosettes, the dorsal tissue covering the sporangia turns chalk-white and spongy, its scales are somewhat smaller and the spore ornamentation is coarser. Furthermore, the distribution ranges of the two species do not appear to overlap, except for two localities at Middelburg and Britstown, in the central Cape, and a doubtful one in northern South West Africa/Namibia.

R. albida Sull., described by Frye & Clark (1937) as having a white, spongiose dorsal surface (which they called 'calcified'), differs in other respects from *R. albolimbata* by being a small plant, 2–4 mm long and 1,1 mm wide; the ventral scales are minute and the spores nearly smooth. Na-Thalang (1980) regarded *R. austinii* Steph., *R. albolimbata* S. Arnell, *R. albosquamata* S. Arnell and *R. albomarginata* Bisch. as species closely related to *R. lamellosa* Raddi. However, *R. albomarginata* belongs to section *Pilifer* Volk, which is endemic to South Africa and is characterized by a dorsal epithelium of loose cell pillars (Volk 1983). *R. lamellosa* [= *R. austinii* (Müller 1954)], is a larger plant with thallus lobes up to 20 mm long and with a somewhat different spore wing and spore ornamentation (Jovet-Ast 1986), neither has it been recorded from southern Africa.

2. **Riccia albosquamata** *S. Arnell*, Mitteilungen aus der Botanischen Staatssammlung, München: 266 (1957); 1963: 25.

TYPE.—SWA/Namibia, Damaraland, 1918 (Grootfontein): Neitsas, am Rande einer Kalkpfanne (–CA), 1956 *Volk 452* p.p. (M!, holo.). 2017 (Waterberg): OTJ147 (–CA), *Volk 881* p.p. (M!, PRE!, para.).

Arnell (1957, 1963) recognized two species, *R. albolimbata* and *R. albosquamata* on the basis of the following (see also Table 1):

(i) the monoicism or dioicism of the plants;
(ii) the so-called differences in the colour, size and branching of the thalli;
(iii) differences in the shape of the dorsal groove, margins and flanks;
(iv) the thin-walled subspherical or cubic-shaped dorsal epithelial cells;
(v) the hyaline or white-spotted scales with, respectively, thin or thick cell walls;
(vi) the different 'texture' of the spores, i.e. ± 12–14 areolae across the diameter, forming a reticulum without papillae, in his spore drawing [Table I, Figure 2 (1957), Figure 14 (1963)], as opposed to 7–8 areolae across the spore diameter [Table II, Figure 1 (1957), Figure 15 (1963)], with 'processes of the reticulum (projecting) as spines in the wing'.

The holotype collection of *R. albosquamata, Volk 452*, is a mixed gathering which also contains *R. trichocarpa* Howe and *R. atropurpurea* Sim and several branches of a white-scaled species. Detailed investigations of the white-scaled material resulted in the following findings: the plant appears to be monoicous, as *R. albolimbata* was also found to be, and the branching, shape and size of the lobes fall within the normal range for *R. albolimbata*. The material is, of course, no longer fresh and green and dorsally it has turned whitish. The groove is only distinct apically, flattening out and becoming slightly concave proximally. The margins are subacute, the flanks are steeper and less sloping than

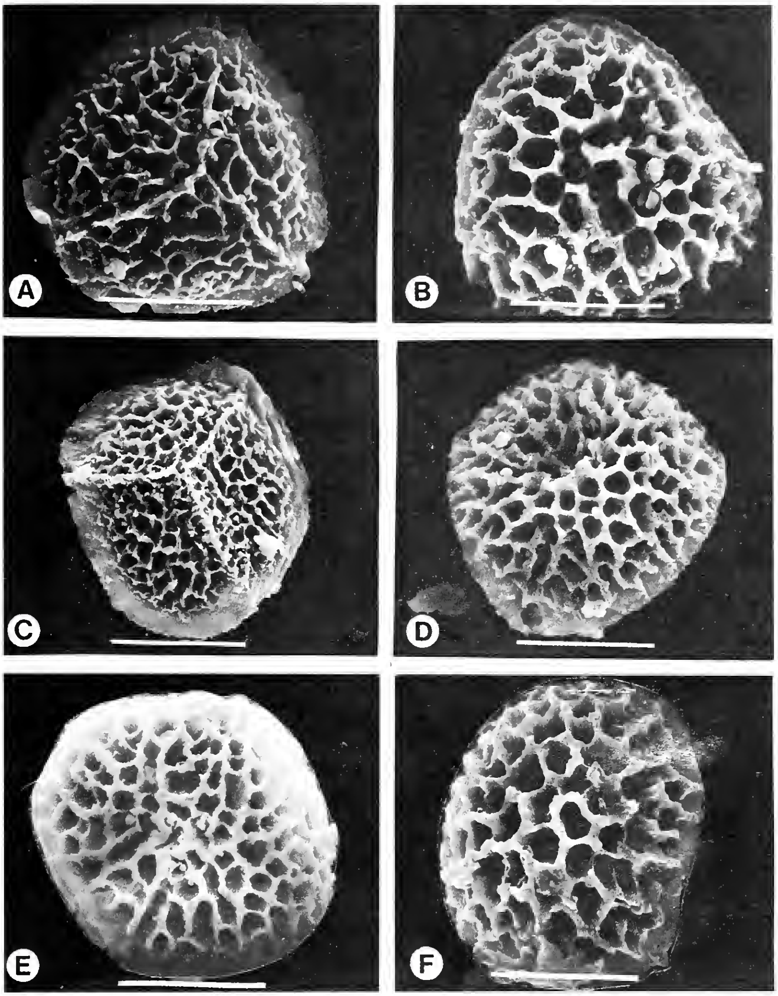

FIGURE 4.—*Riccia albosquamata*, *Volk 452*, holotype. Spores. A, proximal face; B, distal face (spores from sporangium in larger thallus); C, proximal face; D, distal face (spores from sporangium at base of thallus); E, distal face (spores from small, loose thallus); F, distal face (spores from small thallus). A–F, SEM micrographs. Scale bar on A–F = 50 μm.

usual and the ventral surface is convex. The dorsal epithelial cells have collapsed, but the pores are 4–5-angled, the latter not commented on by Arnell. The scales are white with a reddish purple base, imbricate, large, 850–1000 × ± 550 μm, and extend above the margin of the thallus; the cells are ± 60–75 × 35 μm (Arnell reported 70 × 50 μm), calcium carbonate granules cover the cell surfaces and do not fill the cell lumens as stated by Arnell. The cell walls are not truly thicker either (Figure 2G). The spores were found to be 70–100 μm in diameter (Table 2) (Arnell reported 70–80 μm), yellow-brown to dark brown, triangular-globular, polar, with the wing (3–)5(–7) μm wide, sometimes with radial folds, pores at the marginal angles and the margin crenulate (Figure 4A); distal face with 8–10 (–12) areolae across (Figure 4B, D, E, F), (5,0–) 7,5–12,5 μm wide and often incomplete; sometimes the branched ridges over the centre of the face are more prominent (Figure 4B, F), as also seen in Arnell's figure. The smaller number of slightly wider areolae Arnell described and illustrated for *R. albosquamata* spores, namely 7 or 8 as opposed to ± 12 he illustrated for *R. albolimbata* spores, are due to several areolae being incompletely separated and becoming confluent. Papillae project from the areolar nodes as in *R. albolimbata* spores. Arnell made no mention of the proximal face, but with thin, irregular ridges and a distinct triradiate mark (Figure 4A, C), it is indistinguishable from that of *R. albolimbata*.

I therefore conclude that the white-scaled branches included in the type gathering of *R. albosquamata* represent *R. albolimbata*. I hereby sink *R. albosquamata* S. Arnell under *R. albolimbata* S. Arnell, because the type collection of *R. albolimbata* represents only one species and the description refers to only one species, whereas *R. albosquamata* is based on a mixed type collection and its description is based on different species.

The identification of the other specimens which Arnell placed under *R. albosquamata* are as follows: *Volk 453* (M, PRE!): the PRE specimen contains only *R. trichocarpa*; *Volk 881* (paratype) (M!, PRE!): *R. albolimbata* and *R. argenteolimbata* Volk & Perold; *Volk 883* (M!, PRE!): *R. albolimbata*, *R. argenteolimbata* and *R. atropurpurea* Sim; *Volk 11906* (M!): *R. argenteolimbata*, *R. okahandjana* S. Arnell, *R. trichocarpa* and *R. atropurpurea*; *Volk 12744* (M!, PRE!): *R. albolimbata* and an unidentified *Riccia* species. None of these white-scaled

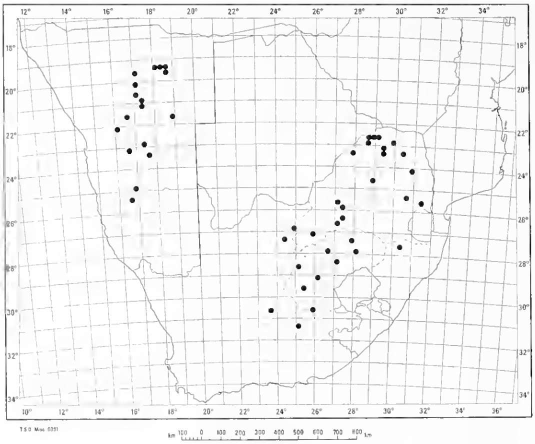

FIGURE 5.—Distribution map of *R. albolimbata* in southern Africa.

specimens, except for the unidentified fragment of *Volk 12744* and *Volk 452*, have spores.

It will be noticed that three of the above specimens also contain *R. argenteolimbata* Volk & Perold in the mixed collections. It is evident that Arnell based his description of *R. albosquamata* on the two white-scaled species, *R. albolimbata* and *R. argenteolimbata*, using characters from both. The references to 'thin and scale-like' margins, perpendicular sides, white scales with pale purple bases 'resembling the scales of *R. limbata* in shape and size' and presumably the 'cubic' dorsal cells, indicate that he referred to the *R. argenteolimbata* part of the collections, whereas the 'concave dorsal face' of the thallus and the spores with a wing (i.e. polar), are *R. albolimbata* characters; *R. argenteolimbata* has a long, sharp dorsal groove and the spores are wingless and apolar, its thallus is compact and the dorsal air pores are mostly triangular, but he did not note this. To give Arnell the credit due to him, he obviously recognized that there were two white-scaled species present, but he failed to distinguish clearly between them. As concluded above, *R. albosquamata* is a taxonomic synonym of *R. albolimbata*; *R. argenteolimbata* has been described as a new species (Volk *et al.* 1988).

SPECIMENS EXAMINED

SWA/NAMIBIA.—1917 (Tsumeb): Farm Kumkauas (–CA), *E. Retief 1459* (PRE). 1918 (Grootfontein): Ossa, on dolomite (–AC), *Volk 81-146* (M, PRE); Gaikos (–A*Volk 84-703* (M, PRE); Neitsas (–BC), *Volk 452* (M). 2017 (Waterberg): Oros 98 (–AA), *Hoffmann PRE-CH 4516* (PRE); OTJ 147 (–CA), *Volk 881* p.p., *883* p.p. (M, PRE); Wilhelmstal (–CD), *Volk 84-717, 84-721* (M, PRE). 2116 (Okahandja): Erichfelde, auf Kalk (–DA), *Volk 11946* (M, PRE). 2118 (Steinhausen): Gobabis, Farm Sturmfeld (–DB), *Toelken 5558* (PRE). 2216 (Otjimbingwe): OM 37 Otjua (–AA), *Volk 81-115* (M, PRE). 2217 (Windhoek): Rietfontein, on calcareous crust (–CD), *Volk 81-265* (M, PRE); Binsenheimkamp (–CD), *Volk 11080* (M, PRE); Wilhelmstal (–CD), *Volk 84-717* (M, PRE). 2316 (Nauchas): Farm Naos, on calcareous crust (–BA), *Volk 81-200* (M, PRE). 2317 (Rehoboth): Gravenstein (–BC), *Volk 11705* (M, PRE). 2416 (Maltahohe): MAL 98 (–DD), *Volk 01254a* (M). 2516 (Helmeringhausen): Duwisib (–BC), *Volk 12744* p.p. (M, PRE).

TRANSVAAL.—2228 (Maasstroom): Alldays, 55 km W of, on calcrete soil (–DA), *S. M. Perold 770* (PRE); Gregory Halt (–DA), *S. M. Perold 737* (PRE); 38 km W of Alldays (–DB), *S. M. Perold 759* (PRE); Bulkop, on calcrete soil (–DC), *S. M. Perold 793-795* (PRE). 2229 (Waterpoort): Chasa (?), Limpopo River, precise locality unknown, *Stephansen 5393* (BOL); 4 km W of Alldays, Farm Bavaria (–CA), *S. M. Perold 733* (PRE); Wylie's Poort (–DD), *S. M. Perold 803* (PRE). 2327 (Ellisras): Villa Nora, 29 km NW of Farm Fransch-hoek (–BD), *Smook 4231* (PRE). 2329 (Pietersburg): Vivo, 15 km N of (–AB), *S. M. Perold 725* (PRE); Dendron, 25 km S of (–AD), *S. M. Perold 719* (PRE). 2330 (Tzaneen): Lebowa Ga-Modjadji (–AD), *Glen 1400, 1404* (PRE). 2428 (Nylstroom): between Groen-vallei and Roedtan, Farm Zoetkoppies (–DB), *S. M. Perold 339* (PRE). 2430 (Pilgrim's Rest): Phalaborwa, Farm Parsons 155, next to Olifants River (–BB), *Venter 12197* (PRE). 2527 (Rustenburg): 14 km N of Rustenburg, on calcareous soil (–CA), *S. M. Perold 222, 228* (PRE); Maanhaarrand, on soil at streamside (–CD), *S. M. Perold 454* (PRE). 2530 (Lydenburg): Sudwala, on earth bank (–BC), *S. M. Perold 398* (PRE). 2531 (Komatipoort): Kaapmuiden, Kaapse plateau (–CB), *Vogel T136* (Mainz). 2627 (Potchefstroom): Wonderfontein-spruit, 6 km N of Carltonville (–AD), *S. M. Perold 1026* (PRE); Gerhardminnebron (–CA), *Ubbink 1156* (PUC); Venterskroon (–CA), *Ubbink 1291* (PUC). 2725 (Bloemhof): Wolmaransstad, Farm Leeufontein (–BB), *A. E. van Wyk 5753* p.p. (PRE).

NATAL.—2730 (Vryheid): Burgers Pass (–CB), *S. M. Perold 699* (PRE).

O.F.S.—2726 (Odendaalsrus): Odendaalsrus (–DC), *Smook 6583a*; *6584* p.p. 2727 (Kroonstad): Heilbron, at stream, N of town (–BD), *S. M. Perold 1369* (PRE). 2728 (Frankfort): Wonderfonteinspruit, 40 km from Bethlehem on road to Lindley (–CC), *S. M. Perold 1365* p.p.; *1366* (PRE). 2825 (Boshof): Farm Goedehoop (–CA), *Volk 81-204* p.p., *81-210* (M, PRE). 2827 (Senekal): Allemanskraal, plateau near caravan park (–AC), *Volk 81-041, 81-231* p.p., *81-214* p.p., *84-653* (M, PRE). 2925 (Jagersfontein): Fauresmith (–CB), *Duthie 5441C, 5445, 5449* (BOL). 2926 (Bloemfontein): Bloemfontein (–AA), *Duthie 5507, 5519* (BOL); Eagle's Nest (–AA), *Geo. Potts CH 1010, CH 1036b* (PRE); *Henrici CH 3741* p.p. (PRE); *Volk 81/289* p.p. (M, PRE). 3025 (Colesberg): H. F. Verwoerd Dam, watercourse (–CB), *S. M. Perold 950, 951* (PRE).

CAPE.—2624 (Vryburg): 8 km E of Vryburg (–DD), *S. M. Perold 1380* (PRE). 2724 (Taung): Reivilo, Farm Sebete Tsapitse 899 (–AD), *Venter 12457* (PRE). 2823 (Griekwastad): precise locality unknown, *Wilman 5517* (BOL). 3023 (Britstown) Britstown (–DA), *Duthie 5469* (BOL). 3125 (Steynsburg): Middelburg, Doornberg (–AC), *Duthie 5110, 5438* (BOL).

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Bothalia 19,1: 27−40 (1989)

Notes on African plants

VARIOUS AUTHORS

ASTERACEAE

A NEW SPECIES OF *INEZIA* (ANTHEMIDEAE) FROM THE NORTH-EASTERN TRANSVAAL

Inezia speciosa *Brusse*, sp. nov.

Herba perennis, erecta, usque ad 450 mm alta (Figure 1). *Caulis principalis* simplex vel ad basim biramosus, erectus, 2−4 mm crassus, in scapum productus, hirsutus, parce foliatus, ad subbasim multiramosus. *Caules secundarii* subbasales, multi, simplices vel subsimplices, dense foliati, hirsuti, ascendentes, subaeque alti terminantes. *Folia* usque ad 20 mm longa, sat dense hirsuta, superioribus simplicibus, inferioribus imparipinnatisectis, usque ad trijugatis, segmentis principalibus cuneatis vel linearibus, segmentis terminalibus lineari-lanceolatis, marginibus involutis, apicibus glabris, scleroticis, saepe fuscis. *Folia axillaria* in axillis foliorum pinnatisectorum vulgaria, simplicia, filiformia vel lineari-lanceolata, uni- vel bigeminata, pari secundo semper breviore. *Inflorescentia* simplex. *Scapus* solitarius, ex caule principali productus, hirsutus, perparce foliatus. *Capitulum* solitarium, radiatum, ligulis exclusis usque ad 25 mm diametro, plus quam 100-florum. *Bracteae involucri* 3−4-seriatae, subaequales, anguste-lanceolatae, externe rufae hirsutae, interne glabrae, 1−1,5 mm latae, 6−9 mm longae, exteriores interioribus angustiores. *Receptaculum* nudum. *Flores ligulati* circa 25−30, feminei sed steriles. *Ligulae* albae, quam bracteas multo longiores, simplices vel profunde trilobatae, parce pubescentes, glandibus bicellulosis superficiaribus; cellulae paginae superioris breviter botuliformes, radiatim leviter striatae; tubus brevis, circa 1 mm longus. *Androecium* nullum. *Stylus* 1,7−1,8 × 0,16−0,23 mm, ad apicem versus biramosus, ramis 0,46−0,54 mm longis, truncatis, base parum dilatata. *Nectarium* nullum. *Ovarium* non bene evolutum, glandibus bicellulosis, superficiaribus. *Ovulum* redactum. *Pappus* nullus. *Flores disci* hermaphroditi, fertiles, plus quam 100, 4,2−5,7 mm longi. *Corolla* lutea, 2,5−3,0 mm longa, glandibus bicellulosis superficiaribus, anguste infundibuliformis vel cylindrica, tetralobata; lobi 0,4−0,5 mm longi, quum maturi patens; margines incrassati, cellulis elongatis protrudentibus, parietibus crassis et longitudine striatis; cellulae paginae interioris transverse striatae. *Stamina* quaterna, tubo corollae supra basin sed infra medium affixa. *Filamentum* breve, 0,44−0,55 mm longum; collum filamenti 0,29−0,33 × 0,10−0,11 mm; cellulae in sectione longitudinali 6−8-seriatae; thecae 0,96−1,11 mm longae; appendix apicalis oblonga, obtusa vel truncata, 0,15−0,20 × 0,19−0,23 mm; caudae 0,04−0,10 mm longae. *Stylus* circa 2,6 × 0,19−0,21 mm, ad apicem versus biramosus, ramis 0,63−0,66 mm longis, truncatis. *Stylopodium* 0,34−0,46 mm latum, 0,17×0,23 mm altum, cellulae parietibus valde incrassatis. *Nectarium* 0,29−0,32 mm latum, 0,10−0,11 mm altum, sub stylopodio. *Ovarium* 1,7−2,7 mm longum, tetracostatum, ubi maturum complanatum, alis marginalibus angustis sed sursum latioribus, glandibus superficiaribus, bicellulosis vel breviter biseriatis (usque ad tres cellulae altis). *Pappus* nullus.

TYPE.—Transvaal, 2329 (Pietersburg): Iron Crown Mountain near Haenertsburg, grassy slopes, alt. 5 500′ (−DD). *L. E. Codd 9440*, 24.1.1956 (PRE, holo.; K, MO, iso.). Figure 1.

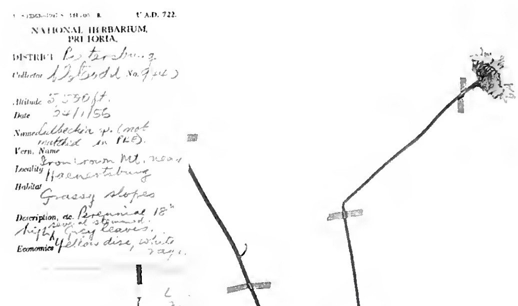

FIGURE 1.—*Inezia speciosa* Brusse, habit. *L. E. Codd 9440*, holotype.

Erect perennial herb, up to 450 mm high. *Main stem* simple to two-branched at base, erect, 2−4 mm thick, produced into scape, hirsute, sparsely leafy, subbasally many-branched (without the main stem branching).

Secondary branches subbasal, numerous, simple to subsimple, densely leafy, hirsute, ascending, terminating at subequal height. *Leaves* up to 20 mm long, moderately densely hirsute, the upper (younger) simple, the lower (older) imparipinnatisect, up to trijugate, main segments cuneate to linear, terminal segments linear-lanceolate; margins involute; apices glabrous, sclerotic, often brown. *Axillary leaves* common in axils of pinnatisect leaves, simple, filiform to linear-lanceolate, one- or two-paired, the second (younger) pair always shorter. *Inflorescence* simple. *Scape* solitary, produced from main stem, hirsute, very sparsely leafy. *Head* solitary, radiate, up to 25 mm diam. excluding rays, more than 100-flowered. *Involucral bracts* 3–4-seriate, subequal, narrowly lanceolate, rufous hirsute on outer surface, glabrous on inner surface, 1–1,5 mm wide, 6–9 mm long, the outer narrower than the inner. *Receptacle* nude. *Ray florets* 25–30, female but sterile. *Rays* white, much longer than bracts, simple to deeply trilobate, sparsely pubescent, with superficial bicellular glands (Figure 2); cells of the upper surface shortly (dumpy) botuliform, radially lightly striate (fingerprinted); tube short, about 1 mm long. *Androecium* absent. *Style* 1,7–1,8 × 0,16–0,23 mm, two-branched towards apex; branches 0,46–0,54 mm long, truncate; base only slightly thickened. *Nectary* absent. *Ovary* not well developed, with superficial bicellular glands. *Ovule* reduced. *Pappus* absent. *Disc florets* bisexual, fertile, more than 100, 4,2–5,7 mm long. *Corolla* yellow, 2,5–3,0 mm long, with superficial bicellular glands, narrowly funnel-shaped to cylindrical, tetralobate; lobes 0,4–0,5 mm long, spreading when mature; margins thickened, with protruding elongated cells, with thickened and longitudinally striate (fingerprinted) walls (Figure 4); cells of the inner surface transversely striate (fingerprinted). *Stamens* 4, attached to corolla tube above base but below middle. *Filament* short, 0,44–0,55 mm long; filament collar 0,29–0,33 × 0,10–0,11 mm, cells 6–8-seriate in longitudinal section; anther thecae 0,96–1,11 mm long; apical appendage oblong, obtuse to truncate, 0,15–0,20 × 0,19–0,23 mm; tails 0,04–0,10 mm long. *Style* around 2,6 × 0,19–0,21 mm, two-branched towards apex, branches 0,63–0,66 mm long, truncate. *Stylopodium* 0,34–0,46 mm wide, 0,17–0,23 mm high; cells with thick walls. *Nectary* 0,29–0,32 mm wide, 0,10–0,11 mm high, under stylopodium. *Ovary* 1,7–2,7 mm long, four-ribbed, flattened when mature, marginal wings narrow but broadened above, superficial glands, bicellular to shortly biseriate (up to three cells high; Figure 3). *Pappus* absent.

In placing this new species in the monotypic *Inezia* Phill., the circumscription of the genus has had to be changed. Phillips (1932) originally separated *Inezia* from *Lidbeckia* Berg. (a genus with two species) mainly on the fertile ray florets, and the distribution—*Lidbeckia* being a genus of the Cape floral area, whereas *Inezia* is a genus of mountainous grassland in the eastern Transvaal and Swaziland. However, this new species breaks this distinction down, because it has ray florets with ovules of similar reduction to *Lidbeckia quinqueloba* (L.f.) Cass. In any case, the ray florets of the only hitherto known species of *Inezia*, *I. integrifolia*, are not perfectly fertile, the ovules being slightly degenerate, but nevertheless present. *I. speciosa* has an even more reduced ovule in the ray achenes. The type of *Lidbeckia*, *L. pectinata* Berg., has ray florets which are completely sterile, with no style and the achene severely reduced, with no ovule present. *Lidbeckia quinqueloba* (L.f.) Cass., on the other hand, has the style developed, with two unequal branches with rounded, rather than truncate apices. A rudimentary ovule is also discernible in the achene. All four species have the achene surfaces with broad bicellular glands (Figure 2) which sometimes become three-tiered (Figure 3). These are also present on the rays, but are more sparse here. The degree of reduction of the ray floret no longer seems to hold well as a distinguishing character between these two genera.

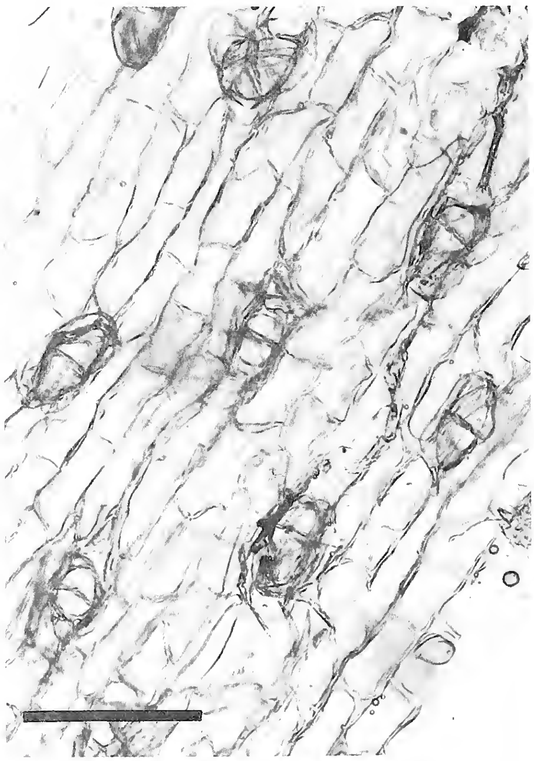

FIGURE 2.—*Inezia speciosa* Brusse, photomicrograph of the bicellular glands. *L. E. Codd 9440*, holotype. Bar = 0,10 mm.

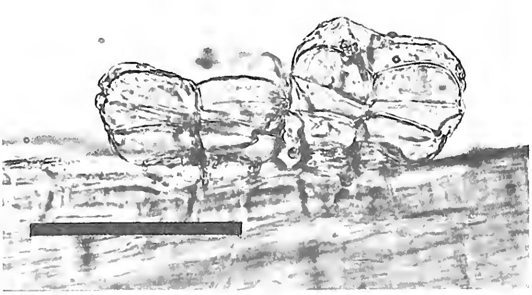

FIGURE 3.—*Inezia speciosa* Brusse, photomicrograph of the three-tiered biseriate glands. *L. E. Codd 9440*, holotype. Bar = 0,10 mm.

FIGURE 4.—*Inezia speciosa* Brusse, photomicrograph of the elongated cells on the margin of the lobes of the disc florets, showing the longitudinal striations. *L. E. Codd 9440*, holotype. Bar = 0,10 mm.

The stylopodium, however, proves to be a useful distinguishing character between these two genera. The stylopodium of *Inezia*, consists of cells that are thick-walled, whereas those of *Lidbeckia* are thin-walled. The nectary, a doughnut-shaped mass of delicate cells, with many stomatal openings on the surface, occurring just below the stylopodium, and surrounding the core of the stigma base, is conspicuously larger in *Lidbeckia* than in *Inezia* disc florets. The filament collars are also more robust in *Lidbeckia*, with 9–10 rows of cells across, than *Inezia*, with 5–8 rows of cells across.

Otherwise the four species (two of *Inezia* and two of *Lidbeckia*) are fairly similar, particularly in the flattened, narrowly winged achenes, the oblong apical anther appendages which are obtuse to truncate, and the presence of broad bicellular glands (Figure 2) on the surfaces of both the disc and the ray achenes and corollas, as well as on the bracts.

These characters are like those of *Osmitopsis* (Bremer 1972), but this genus has a paleate receptacle, long-tailed anthers, five corolla lobes and sometimes a lacerate, scarious, sleeve-like pappus. The bicellular glands, although similar in shape to those of *Inezia* and *Lidbeckia,* appear to contain resin or terpenes to the exclusion of everything else, and appear submacroscopically as resin droplets. The glands of *Inezia* and *Lidbeckia* do not have this appearance, and the contents appear aqueous (Figure 2).

The cells on the inner surface of the disc corolla lobes of all four species are transversely striate (fingerprinted). The cells on the ray surface are more specialized. The ray surface cells of *I. integrifolia* are rounded with thick walls and cross striations (fingerprinting). The ray surface cells of *I. speciosa* are obtusely acuminate, or botuliform, and faintly radially striate. *Lidbeckia pectinata* ray surface cells are ellipsoid, and faintly radially striate. The ray surface cells of *L. quinqueloba* are the most spectacular of the four, with obtusely acuminate or botuliform shape, with radial striations, and with the cell bases 5–8 crenate with the axils of the crenations thickened. However these various structures do appear to be generically significant.

At present this new species is known only from the type collection, from the lower slopes of Iron Crown Mountain near Haenertsburg, in the north-eastern Transvaal.

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A NEW *PHYMASPERMUM* (ANTHEMIDEAE) SPECIES FROM DOLOMITE AREAS OF THE WOLKBERG

Phymaspermum argenteum *Brusse*, sp. nov.

Suffrutex usque ad 850 mm altus, ex caudice ligneo bulbiformi 40–50 mm diametro perenni oriens. *Caules* basi simplices vel versus apicem ramosi, 2–8 mm diametro, praeter partes basales dense foliati, parce vel dense tomentosi. *Folia* usque ad 25 mm longa, imparipinnatisecta vel simplicia, non- vel trijugata, segmentis filiformibus vel linearibus, circa 1 mm latis, segmentis inferioribus quam segmentis superioribus longioribus, argenteo-hirsutis, apicibus glabris, scleroticis. *Inflorescentia* terminalis, corymbosa, capitulis numerosis, pedunculis foliis parvis. *Capitula* discoidea, cylindrica, 4–7 × 2–3 mm, 10–17-flora. *Bracteae involucri* 3–4- seriatae, interiores exterioribus longiores, lanceolatae, interiores 5–6 × 1 mm, concavae, marginibus apicibusque scariosis. *Receptaculum* nudum. *Flores* omnes fertiles, omnes hermaphroditi, 4,5–6,0 mm longi. *Corolla* lutea, 3–3,5 mm longa, prope basin anguste cylindrica, supra basin campanulata, quinquelobata, lobis 0,4–0,8 mm longis, glanduloso-pilosa, glandibus biseriatis. *Filamentum* breve, 0,65–1,00 mm longum; collum filamenti 0,24–0,37 mm longum, ad basin 0,09–0,14 mm diametro; cellulae in sectione longitudinali 7–10 seriatae; thecae 0,93–1,15 mm longae; appendix apicalis lanceolata, 0,23–0,37 × 0,13–0,16 mm; caudae usque ad 0,17 mm longae (Figure 7). *Stylus* 2,4–2,7 × 0,13–0,24 mm, ad apicem

versus biramosus, ramis 0,5–0,7 mm longis, truncatis. *Stylopodium* 0,24–0,42 mm latum, cellulis non vel leviter incrassatis. *Nectarium* sub stylopodio, 0,27–0,42 mm latum, 0,14–0,20 mm altum. *Ovarium* 1,0–2,5 mm longum, decacostatum, glandibus bicellulosis superficiaribus numerosis (Figure 6); apex annulo incrassato, laevis vel decadentatus.

TYPE.—Transvaal, 2429 (Zebediela): 18 km from the main Pietersburg-Tzaneen road near Boyne to Wolkberg Estates. One km from the turn-off to Frosch Farm to Wolkberg Estates. On highest point on road. Erect to reclining, 0,5–0,85 m tall, silvery subshrub, with yellow flower heads, growing as isolated plants in grassland or open woodland, near low rock outcrops. On rolling dolomite hill at NW base of prominent NE-SW running dolomite ridge. Crushed leaves without strong odour. Soil a brown loam. Not seen on dolomite ridge, but fairly common on rolling hill below (–BB). *F. Brusse 5567*, 30.05.1988 (PRE, holo.; B, BM, BR, C, E, GRA, K, LD, M, MEL, MO, NBG, P, S, UPS, US, WAG, iso.). Figure 5.

FIGURE 5.—*Phymaspermum argenteum* Brusse, habit. *F. Brusse 5567*, holotype.

Subshrub to 850 mm high, arising from a woody perennial bulb-shaped caudex, 40–50 mm diam., just below soil level. *Stems* simple at base to branched above, 2–8 mm diam., densely leafy except towards base, sparsely to densely tomentose. *Leaves* up to 25 mm long, imparipinnatisect to simple, non- to trijugate, segments filiform or linear, about 1 mm wide, lower segments longer than upper segments, silvery-hirsute, tips glabrous, sclerotic. *Inflorescence* terminal, corymbose, heads numerous, peduncles small-leafy. *Heads* discoid, cylindrical, 4–7 × 2–3 mm, 10–17-flowered. *Involucral bracts* 3–4-seriate, inner ones longer than outer ones, lanceolate, inner bracts 5–6 × 1 mm, concave, margins and apices scarious. *Receptacle* nude. *Flowers* all fertile, all hermaphrodite, 4,5–6,0 mm long. *Corolla* yellow, 3,0–3,5 mm long, narrowly cylindrical below, campanulate above, five-lobed, lobes 0,4–0,8 mm long, glandular pilose, glands biseriate. *Filament* short, 0,65–1,00 mm long; filament collar 0,24–0,37 × 0,09–0,14 mm below; cells 7–10 seriate in longitudinal section; thecae 0,93–1,15 mm long; apical appendage lanceolate, 0,23–0,37 × 0,13–0,16 mm; tails up to 0,17 mm long (Figure 7). *Style* 2,4–2,7 × 0,13–0,24 mm, two-branched towards apex, branches 0,5–0,7 mm long, truncate. *Stylopodium* 0,24–0,42 mm wide, cells not to only slightly thickened. *Nectary* below stylopodium, 0,27–0,42 mm wide, 0,14–0,20 mm high. *Ovary* 1,0–2,5 mm long, ten-ribbed, superficial bicellular glands numerous (between ribs; Figure 6); apex with thickened rim, smooth to ten-toothed.

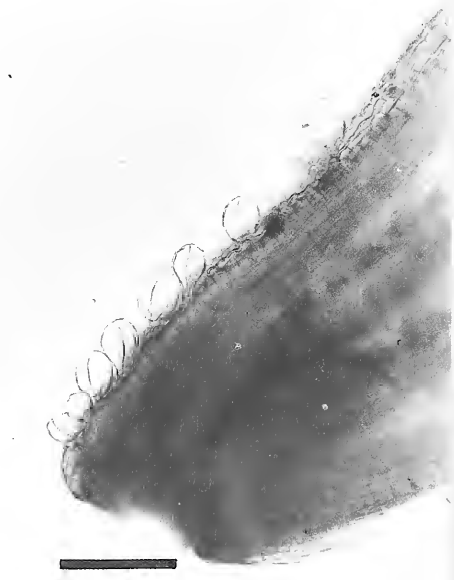

FIGURE 6.—*Phymaspermum argenteum* Brusse, photomicrograph showing the bicellular glands on the achene surface. *D. R. J. van Vuuren 1533*, paratype. Bar = 0,10 mm.

This new species of *Phymaspermum* superficially resembles *Phymaspermum acerosum* (DC.) Källersjö, except for the dense silvery hairiness of the leaves. The leaves of *P. acerosum* are normally almost hairless when mature. The hairs, mainly on the undersurface, are not visible to the unaided eye and are longer than those of *P. argenteum*. The inflorescences of the two species are quite similar, but the heads contain more flowers in *P. argenteum* (10–17) than in *P. acerosum* (4–9; Hilliard 1977).

FIGURE 7.—*Phymaspermum argenteum* Brusse, photomicrograph showing the anther tails. *D. R. J. van Vuuren 1533*, paratype. Bar = 0,10 mm.

The anther tails of *Phymaspermum argenteum* are longer (Figure 7) than those of *P. acerosum*, which are quite short, and the anther bases could be described as being merely acute. However, this would be misleading in this case as the cellular structure at the base seems quite similar, and the cells of the tails of *P. argenteum*, are more elongated than those of *P. acerosum*.

Phymaspermum acerosum is one of the three problem species in this genus, in that the achenes lack all traces of superficial bicellular glands (Källersjö 1985), but *P. argenteum* is typical, with abundant superficial bicellular glands, between the blunt ribs on the achene (Figure 6).

P. argenteum is not a very conspicuous plant and does not grow much taller than 0,85 m. *P. acerosum*, on the other hand, can grow up to two metres (2 m) tall, and is a large and conspicuous plant of higher altitudes.

Phymaspermum acerosum grows in acidic soils, and has not been recorded from alkaline soils. *P. argenteum*, however, grows in alkaline soils in dolomite areas of the eastern Transvaal, and so far has only been recorded from the dolomitic regions of the Wolkberg.

TRANSVAAL.—2429 (Zebediela): erect semiwoody herb from stout rootstock. Viscous. Heads yellow. Dolomite formation, Wolkberg Plateaux 14 m. SE of Boyne (—BB). *D. R. J. van Vuuren 1533*, 3.6.1962 (PRE, K). Wolkberg Estates. Wooded grassland on mountain slope. Gentle. E aspect. Gritty sandy soil. Herb forming isolated stands. Rare. Alt. 1 600 m (—BB). *S. P. Fourie 2759* (ex TPA Nature Cons. Herbarium 633988), 1982.05.26 (PRE).

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MELIACEAE

TURRAEA PULCHELLA REDISCOVERED

The first and previously only collections of *Turraea pulchella* (Harms) Pennington were made by Alice M. Pegler in the Kentani District, Transkei, between April 1900 and October 1913. Originally described by Harms (1917) as the sole member of the genus *Nurmonia*, it was transferred to *Turraea* L. by Pennington & Styles (1975). As more than 70 years have passed without re-collections, the species had been considered to be either extremely rare or extinct.

On September 17, 1987, a few plants of *T. pulchella* were found on the Matabetule Plateau ± 20 km north-west of Durban during a plant collecting trip organized by staff of the Natal Herbarium. During several subsequent visits to the area, *T. pulchella* was found to be locally abundant, particularly in heavily grazed grassland burnt in July/August. The plants had prominent, perennial rootstocks 80—200 mm long, ± prostrate to spreading annual shoots and pure white flowers with a singular spicy fragrance.

The vegetation of the Matabetule Plateau is a mosaic of *Aristida junciformis* Trin. & Rupr. subsp. *junciformis* grassland and bush clumps associated with termitaria. Prominent among the trees are *Syzygium cordatum* Hochst., *Spirostachys africana* Sond., *Combretum molle* R. Br. ex G. Don and *Faurea saligna* Harv. Although many plants of *T. pulchella* grow in open grassland, they also tend to be associated with the isolated low-growing woody shrublets scattered between bush clumps—particularly geoxylic suffrutex forms of *Faurea saligna* and *Sclerocarya birrea* (A. Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro.

The soils on the plateau are very sandy, light grey to reddish and derived from Natal Group Sandstone (formerly known as Table Mountain Sandstone). Fortunately the Matabetule Plateau (which is in KwaZulu) is earmarked as a nature reserve and will form part of the Durban Metropolitan Open Space System (M.O.S.S.).

In its subherbaceous suffrutescent habit *T. pulchella* is very different from most other members of the genus. A rather similar habit is shown by *T. streyi* F. White & B. T. Styles, described in 1986, another rare species known from only two localities in Natal. Subsequent to the rediscovery of *T. pulchella*, several plants of *T. streyi* were relocated at the type locality near St. Michael's-on-Sea. Detailed studies on these two interesting species can now be undertaken to elucidate aspects of their taxonomy, biology and ecology.

VOUCHER SPECIMENS

NATAL.—2930 (Pietermaritzburg): Matabetule Plateau, ± 20 km NW of Durban (—DB). *Van Wyk 8141, 8238* (PRU); *Williams 36, 84* (NH).

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FABACEAE

THE IDENTITY OF *LOTONONIS ELONGATA* (CROTALARIEAE)

Several specimens of a species superficially similar to *Lotononis prostrata* (L.) Benth. and *L. azurea* (Eckl. & Zeyh.) Benth. have accumulated in southern African herbaria since 1953. The herbarium collections and an *in situ* study have shown that the species is quite distinct from all other species of the section *Telina* (E. Mey.) Benth. It was written up to be described as a new species under the name *L. repens* (Van Wyk unpublished manuscript).

A recent examination of the Thunberg Herbarium in Uppsala has revealed that '*L. repens*' is identical to *Ononis elongata* Thunb., a species treated by both Harvey (1862) and Dümmer (1913) as synonymous with *L. prostrata* (L.) Benth. Unlike Harvey, Dümmer apparently did not see the type specimen and presumably followed Harvey's interpretation of the species. Bentham (1843) did not study the Thunberg collection and did not cite *Ononis elongata* in his revision of *Lotononis*. Dietrich (1847) somewhat hesitantly transferred most of Thunberg's *Ononis* species to the genus *Lotononis*—amongst others also *O. elongata*. These and several other new combinations by Dietrich have apparently been overlooked by subsequent workers.

The type specimen of *Ononis elongata* is a small piece of flowering material only, so that the unusual pods, distinctive habit and other diagnostic characters were not known before.

Lotononis elongata *(Thunb.) D. Dietr.*, Synopsis plantarum 4: 960 (1847).

Ononis elongata Thunb., *Prodromus plantarum capensium* 2: 129 (1800); Thunb.: 587 (1823); DC.: 167 (1825); Harv. 2: 53 (1862), as synonym of *L. prostrata*; Dümmer: 296 (1913), as synonym of *L. prostrata*. Type: South Africa, Cape Province, 'in Cap. b. Spei', *Thunberg s.n. sub THUNB-UPS 16607* (UPS!, lecto., here designated).

Prostrate perennial herb up to 1,2 m wide and no more than 0,1 m high. *Branches* prostrate and creeping, spreading from a central rootstock; twigs densely pilose. *Leaves* digitately trifoliolate, very variable in size and shape; petiole (2—) 4—8 (—11) mm long, sparsely pubescent; leaflets oblanceolate, obovate or elliptic, (3—) 7—16 (—20) × (1,5—) 2—5 (—8) mm, abaxially sparsely pubescent, adaxially glabrous. *Stipules* consistently present, single at each node, lanceolate to broadly ovate, (1—) 2—8 (—11) mm long. *Inflorescences* leaf-opposed at each node, slender, long-pedunculate, 25—75 mm long, invariably single-flowered; bracts small, up to 2,5 mm long; bracteoles absent. *Flowers* 10—14 mm long, yellow; pedicel 1—3 mm long. *Calyx* 7—9 mm long, with the lateral lobes on either side fused higher up in pairs, sparsely pubescent. *Standard* large, broadly ovate to orbicular, 11—16 mm long, with a line of hairs dorsally along the middle, adaxially yellow, abaxially pale brown. *Wing petals* dimorphic, the one oblanceolate with an obliquely truncate apex, the other oblong-obovate with a rounded apex, the former positioned higher than the latter at anthesis; both longer than the keel; sculpturing similar in both, upper basal and upper left central, in 5—6 rows of inter- and intracostal lunae. *Keel petals* semicircular, obtuse, auriculate and pocketed near the base. *Anthers* dimorphic. *Pistil* 9—12 mm long; ovary linear, 6—8 mm long, the upper part without ovules and similar to the style, the lower fertile part very short, 2—3 mm long. *Fruit* ovate, terete, very short, 8—14 mm long (excluding the style), 3—6 mm in diameter; apex gradually tapering to the style; pubescent. *Seed* suborbicular in side view, up to 2 mm long, distinctly tuberculate, pale brown or with some irregular black marks; hilar area markedly swollen and black in colour, obscuring the hilar valve (Figure 8). *Chromosome number*: 2n = 28!

Voucher specimen: *Van Wyk 2573* (BOL, C, GRA, JRAU, K, M, MO, NBG, NH, PRE, SAAS, STE).

Lotononis elongata is similar to *L. azurea* and *L. prostrata* but differs from these and related species in the shape of the flowers, the dimorphic wing petals, the sterile upper part of the ovary and in the short, ovate and distinctly pointed fruit. It differs from *L. azurea* also in the yellow colour of the flowers, the shape of the leaflets and the more hairy twigs and leaves. From *L. prostrata* it also differs in the more spreading habit, which can be up to 1,2 m wide (± 0,3 m in *L. prostrata*).

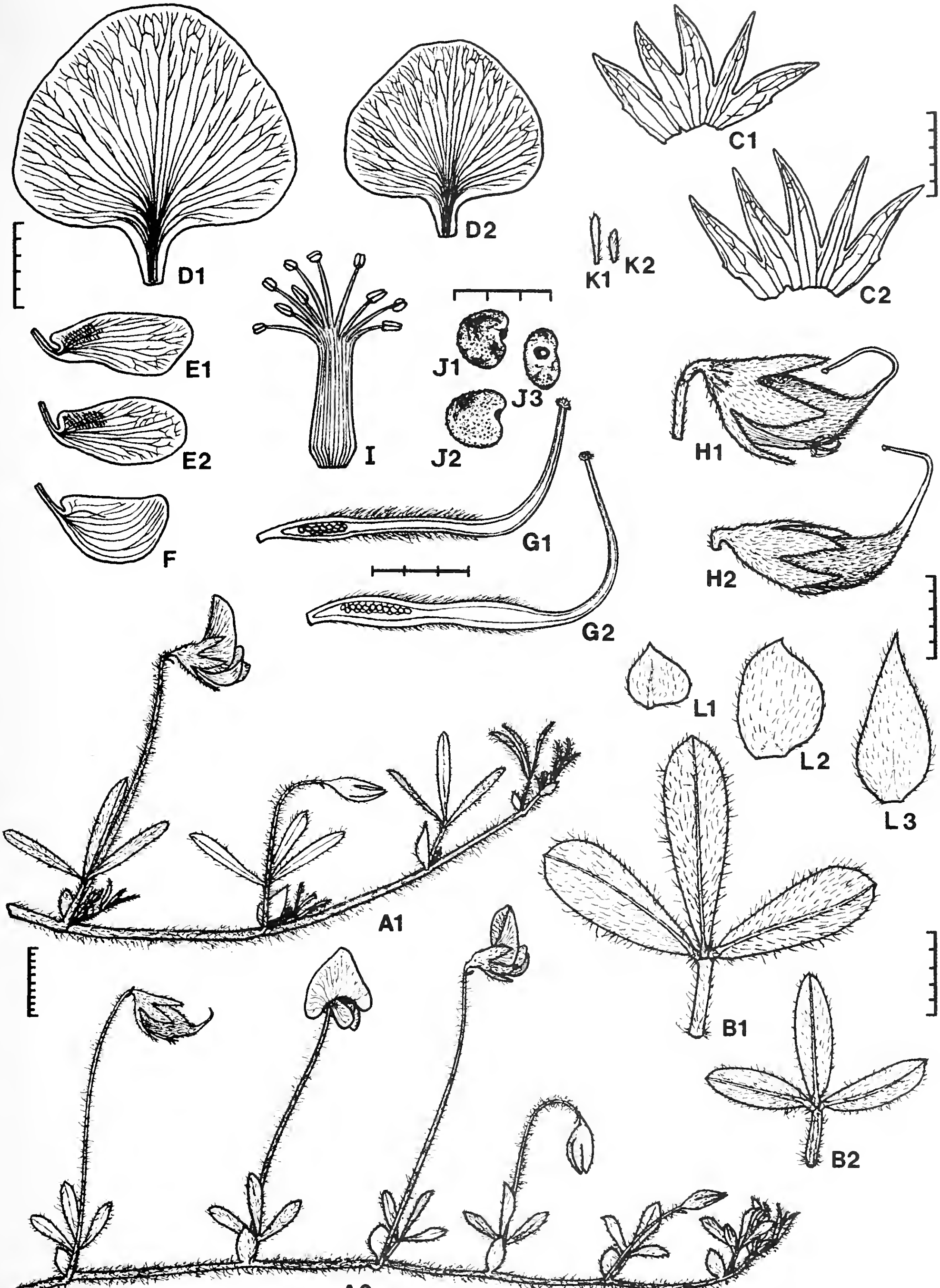

FIGURE 8.—*Lotononis elongata*. A1, A2, flowering branches, showing the prostrate habit and slender peduncles; B1, B2, leaves in abaxial view; C1, C2, calyx opened out, upper lobes to the left, showing the fusion of the lateral lobes; D1, D2, standard petals (note the difference in size); E1, E2, wing petals from the same flower, showing the dimorphic shape; F, keel petal; G1, G2, pistils, showing the sterile upper parts of the ovaries; H1, H2, mature fruit (note the size, shape and also the pointed, tapering apices, which are diagnostic for the species); I, androecium; J1, J2, seeds in side view, showing tuberculate surface; J3, seed in hilar view, showing the raised area around the hilar valve; K1, K2, bracts; L1, L2, L3, stipules, showing variation in size and shape. All from *Van Wyk 2573* except A1 & B2 from *Vlok 1762* and C2, D1, G2, I & L2 from *Vlok 1718*. Scales in mm.

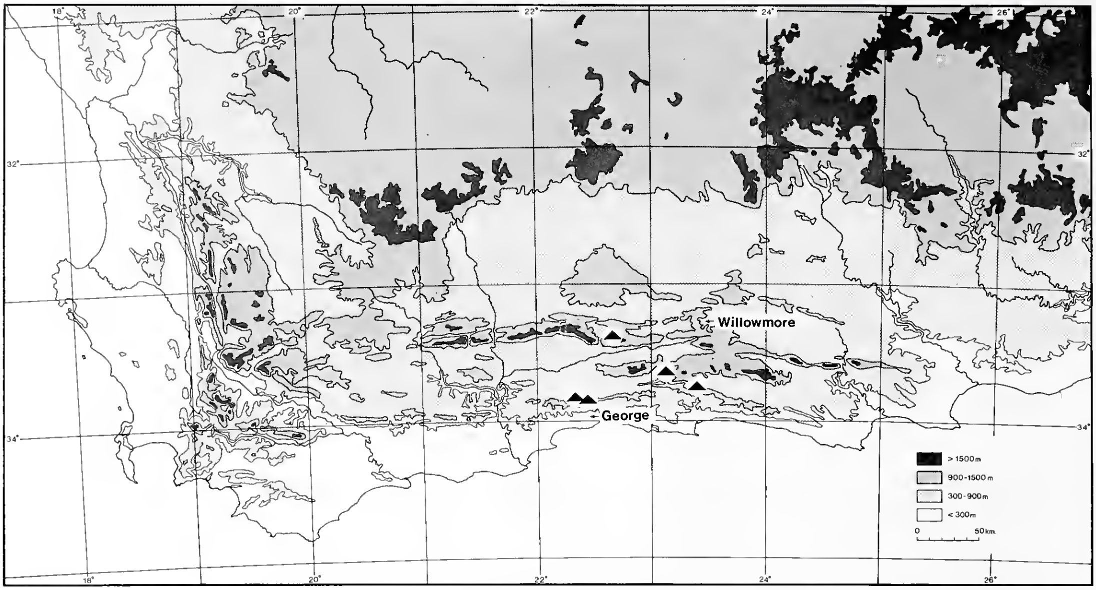

FIGURE 9.—The known geographical distribution of *Lotononis elongata*.

The species has a relatively wide distribution in the southern Cape (Figure 9). It seems to have escaped the notice of collectors for nearly 200 years—recent collections date back to 1953. Thunberg must have collected the type specimen on one of his two journeys to the eastern Cape between 1772 and 1774. It is known that he crossed the Outeniqua Mountains on several occasions during this period (Gunn & Codd 1981). Recent collections by Mr J. H. J. Vlok (Saasveld Forestry Research Centre, George) have considerably expanded the known distribution range.

The peculiar pistil, in which the upper sterile part of the ovary closely resembles the style, has not been observed in any other species of the section *Telina*. This development approaches the usual condition in the genus *Crotalaria* (where the style is geniculate and hairy), but in *L. elongata* the hairy part of the pistil is undoubtedly part of the ovary and not the style. The presence of macrocyclic pyrrolizidine alkaloids in *L. elongata* (Van Wyk & Verdoorn in prep.) also suggests an affinity with *Crotalaria*. The single stipules, calyx structure, tuberculate seed surface and chromosome number, however, leave little doubt about the correct generic position in *Lotononis*.

CAPE.—3322 (Oudtshoorn): Swartberg Mountains, mid-northern slopes of Blesberg, next to forestry track (–BC), 15.12.1986, *Vlok 1762* (JRAU, K, NBG, PRE); northern foothills of Outeniqua Mountains, about 3 km west of Herold at Camferskloof (–CD), 22.11.1986, *Vlok 1718* (BOL, C, GRA, JRAU, K, M, MO, NBG, NH, PRE, SAAS, STE); top of Outeniqua Pass (–CD), 23.1.1987, *B-E. van Wyk 2573* (PRE, BOL, C, GRA, JRAU, K, M, MO, NBG, NH, PRE, SAAS, STE); Zebra, top of Outeniqua Pass (–CD), 19.10.1953, *Lewis 3734* (SAM); Zebra, George District (–CD), 19.10.1953, *Barker 8195* (MO, NBG). 3323 (Willowmore): about 8 km from Uniondale on road to Avontuur (–CA), 20.12.1967, *Grobbelaar 1401* (PRE); 23,2 km east by south of Uniondale (–CB/–CD), 16.11.1958, *Acocks 19986* (K, M).

ACKNOWLEDGEMENTS

I am indebted to Mr J. H. J. Vlok (Saasveld Forestry Research Centre, George) for valuable collections of *L. elongata* and to Dr and Mrs Charles McDonald (Tarentaalbos, George) who kindly collected ripe fruits and seeds for chromosome counting. The taxonomic study of *Lotononis* is a registered Ph. D. project at the University of Cape Town. Financial support from the Rand Afrikaans University enabled me to study the Thunberg collection.

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FUSCIDEACEAE

A NEW SPECIES OF *FUSCIDEA* (LICHENES) FROM THE CAPE FOLD MOUNTAINS

Fuscidea hottentotta *Brusse*, sp. nov.

Thallus crustosus, saxicola, violaceo-brunneus, ad 80 mm diametro, 100–300 µm crassus, rimoso- vel dissitiareolatus. *Areolae* 0,2–2,0 mm diametro. *Hypothallus* ater, thallum marginans, margine 0,5–2,0 mm lato. *Cortex superior* circa 20 µm crassus. *Stratum gonidiale* 20–100 µm crassum; algae *Protococcoideae*, 5–16 µm diametro. *Medulla* alba, 50–200 µm crassa. *Apothecia* nigella, adnata, lecideina, ad 1,2 mm diametro, marginibus leviter brunneis vel atris, discis atris, planis vel concavis. *Excipulum* pallide brunneum, 35–45 µm crassum, anticlinate paraplectenchymatum, cellulis 4–6,5 µm latis, 4–15,5 µm longis. *Hypothecium* hyalinum, 65–95 µm crassum. *Hymenium* hyalinum, 65–75 µm altum, solum ascis J+ caeruleis; epihymenium brunneum. *Asci* clavati, tholis J+ caeruleis. *Ascosporae* octonae, hyalinae sed mox fuscae, curvae vel reniformes, simplices vel interdum uniseptatae, 11,5–17,5 × 5–8 µm. *Pycnidia* hyalina, ampulliformia, circa 80 µm lata et circa 100 µm profunda. *Pycnidiosporae** hyalinae, rectae, anguste ellipsoideae, acrogenae, 3–5 × 1–1,4 µm. *Thallus* acidum ramalinolicum continens.

TYPE.—3322 (Oudtshoorn): 40 km from the Olifants River bridge near Oudtshoorn to Mossel Bay, Robinson Pass. SW slopes of Ruitersberg. On almost vertical SW Table Mountain Sandstone rock face, on steep SW slope. Alt. 790 m (–CC). *F. Brusse 5312*, 1988.03.12 (PRE, holo.; B, BM, LD, UPS, iso.). Figure 10.

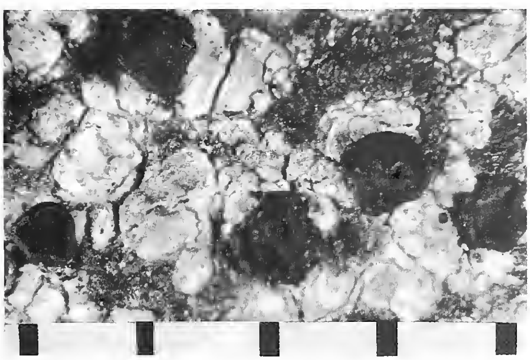

FIGURE 10.—*Fuscidea hottentotta* Brusse. Habit. *F. Brusse 5312*, holotype. Scale in mm.

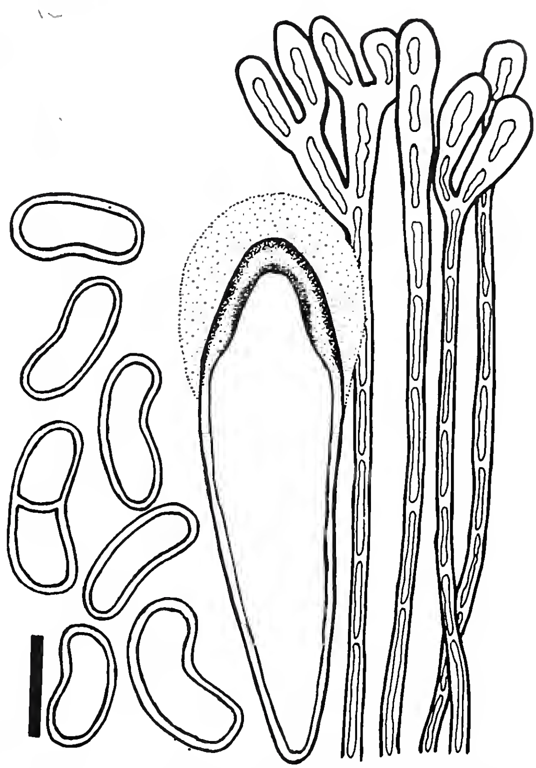

FIGURE 11.—*Fuscidea hottentotta* Brusse. Ascospores, ascus and paraphyses. Stippling indicates the amyloid reaction in Lugol's iodine solution. Heavy lines delineating the paraphyses, indicate brown walls. *F. Brusse 5312*, holotype. Bar = 10 µm.

Thallus crustose, saxicolous, violet-brown, to 80 mm across, 100–300 µm thick, rimose to scattered areolate. *Areoles* 0,2–2,0 mm across. *Hypothallus* black, lining thallus; lining 0,5–2,0 mm broad. *Upper cortex* about 20 µm thick. *Algal layer* 20–100 µm thick; algae *Protococcoid*, 5–16 µm diam. *Medulla* white, 50–200 µm thick. *Apothecia* blackish, adnate, lecideine, to 1,2 mm across, margins light brown to black, disc black, plane to concave. *Exciple* pale brown, anticlinally paraplectenchymatous, cells 4–6,5 µm wide, 4–15,5 µm long. *Hypothecium* hyaline, 65–95 µm thick. *Hymenium* hyaline, 65–75 µm high, only asci J+ blue; epihymenium brown. *Asci* clavate, eight-spored, tholus J+ blue (Figure 11). *Ascospores* 8, hyaline but soon fuscous, curved or reniform, simple but sometimes uniseptate, 11,5–17,5 × 5–8 µm. *Pycnidia* hyaline, ampulliform, about 80 µm wide by about 100 µm deep. *Pycnidiospores** narrowly ellipsoid, hyaline, straight, acrogenous, 3–5 × 1–1,4 µm. *Chemistry*: ramalinolic acid (major) and sekikaic acid (minor to trace).

This new species of *Fuscidea*, is fairly closely related to *Fuscidea cyathoides* (Ach.) V. Wirth & Vězda, but has slightly larger ascospores and significantly longer pycnidiospores. The ascospores are 8,5–14,0 × 4,0–6,5 µm (James, Poelt & Wirth 1981; Oberhollenzer & Wirth 1984), as opposed to 11,5–17,5 × 5–8 µm for *F. hottentotta*. The pycnidiospores of *F. cyathoides* are 2,8–3,5 × 1–1,5 µm (Coppins *in litt.*), whereas those of *F. hottentotta* are longer, being 3–5 × 1–1,4 µm. However, the most conspicuous difference between these two species is the chemistry, with *F. cyathoides* containing fumarprotocetraric and protocetraric acids

* The term pycnidiospore is used here, because it implies any type of spore arising from within a pycnidium, and does not necessarily imply asexuality. As these spores may actually be spermatia (non-motile gametes), the term 'conidium' is avoided, because of its definite asexual connotations.

(James, Poelt & Wirth 1981; Oberhollenzer & Wirth, 1984), and *F. hottentotta* containing ramalinolic acid, with a minor amount of sekikaic acid. This was determined by thin-layer chromatographic comparisons of the hydrolysis products with those of divaricatic and homosekikaic acids, and the hydrolysis data presented by Culberson (1972). A negative homofluorescein test (Asahina & Shibata 1954) and microcrystal tests confirmed this determination.

Thus far this new species has verifiable specimen records from Robinson's Pass, at the western end of the Outeniqua Mountains and from Caledon, and is therefore widespread in the southern Cape Province.

CAPE PROVINCE.—3419 (Caledon): Caledon, Quarzitfelsen oberhalb d. Bades, c. 300 m. *J. Brunnthaler s.n.*, 28.10.1909 (W 460). Cited by Zahlbruckner (1932) as *Lecidea (Biatora) rivulosa* Ach. (= *Fuscidea cyathoides* (Ach.) V. Wirth & Vězda).

SPECIMENS OF OTHER SPECIES EXAMINED

Fuscidea cyathoides (Ach.) V. Wirth & Vězda

CZECHOSLOVAKIA.—4820: Na křemenci na Plešivci. *V. Los s.n.* 1921. (*V. Kuťák, Lichenes Bohemiae 574*; PRE 890).

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A NEW SPECIES OF *MARONEA* (LICHENES) FROM THE DRAKENSBERG

Maronea afroalpina *Brusse*, sp. nov.

Thallus crustosus, basalticola, albidus, ad 20 mm diametro, 0,1–1,0 mm crassus, rimoso-areolatus. *Areolae* 0,1–1,8 mm diametro. *Prothallus* non visus. *Cortex superior* 15–25 μm crassus. *Stratum gonidiale* 30–70 μm crassum; algae *Protococcoideae*, 5–11 μm diametro. *Medulla* alba, 60–900 μm crassa. *Apothecia* nigella, sessilia, ad 1,5 mm diametro, lecideina, marginibus pallide brunneis vel atrobrunneis, discis atris pruina alba tectis. *Excipulum* inferne 40–50 μm crassum, in lateribus 50–70 μm crassum, interne hyalinum vel stramineum, externe brunneum, radiatim paraplectenchymatum, cellulis 3–7 μm diametro, interdum elongatis et usque ad 14 μm longis. *Hypothecium* stramineum, 50–100 μm crassum, paraplectenchymatum, cellulis 3–6 μm diametro. *Hymenium* fertile 70–95 μm altum, hyalinum; epihymenium brunneum. *Paraphyses* simplices sed apices versus ramosae, septatae, 1,3–1,7 μm crassae, capitatae, capitibus 2,8–5,2 μm crassis, brunneis. *Asci* clavati vel acuminate clavati, tholis J+ caeruleis. *Ascosporae* numerosae (± 100 vel ultra), simplices, hyalinae, ellipsoideae, parvae, 5–9 × 3,2–5,2 μm. *Pycnidia* non visa. *Thallus* acidum divaricaticum solum continens.

TYPE.—2828 (Bethlehem): 31 km S of Phuthaditjhaba (Witsieshoek), summit of Western Buttress (Mont-aux-Sources), on vertical S face of basalt boulder outcrop on gentle S slope, alt. 3 080 m (–DB). *F. Brusse 5553*, 1988.04.05 (PRE, holo.; BM, LD, iso.). Figure 12.

Thallus crustose, basalticolous, whitish, to 20 mm diam., 0,1–1,0 mm thick, rimose-areolate. *Areoles* 0,1–1,8 mm diam. *Prothallus* not seen. *Upper cortex* 15–25 μm thick. *Algal layer* 30–70 μm thick; algae *Protococcoid*, 5–11 μm diam. *Medulla* white, 60–900 μm thick. *Apothecia* blackish, sessile, to 1,5 mm diam., lecideine; margins light to dark brown, discs black with white pruina. *Exciple* 40–50 μm thick below, 50–70 μm thick on sides, hyaline to stramineous within, brown towards exterior, radiately paraplectenchymatous, cells 3–7 μm diam., sometimes becoming 14 μm long. *Hypothecium* stramineous, 50–100 μm thick, paraplectenchymatous, cells 3–6 μm diam. *Hymenium* 70–95 μm high wen fertile, hyaline; epihymenium brown. *Paraphyses* simple but branched towards apex (Figure 13), septate, 1,3–1,7 μm thick, capitate, heads 2,8–5,2 μm thick, brown. *Asci* clavate

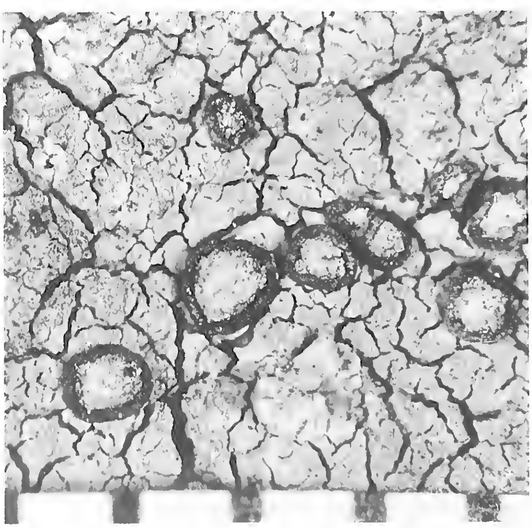

FIGURE 12.—*Maronea afroalpina* Brusse, habit. *F. Brusse 5553*, holotype. Scale in mm.

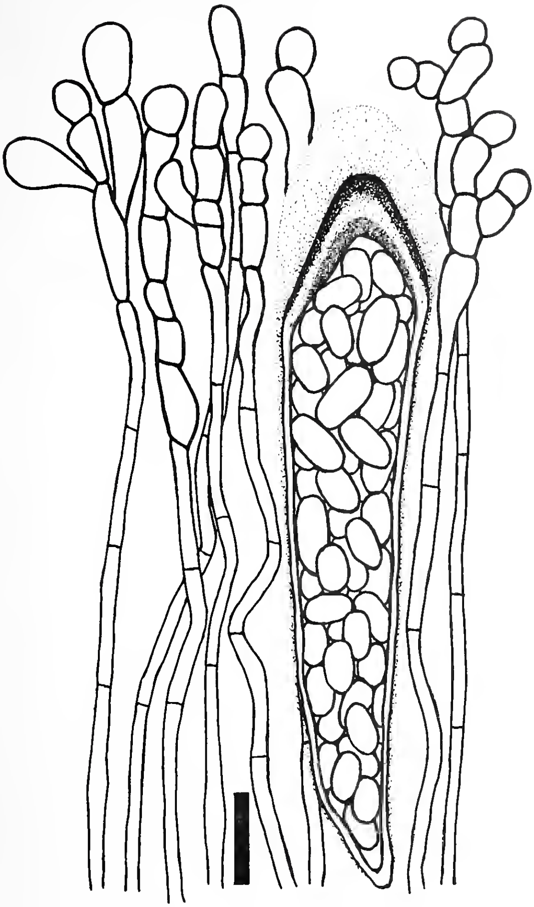

FIGURE 13.—*Maronea afroalpina* Brusse, ascus and paraphyses. The heavy lines at the tips of the paraphyses indicate brown walls. Stippling indicates the reaction in Lugol's iodine solution. *F. Brusse 5553*, holotype. Bar = 10 μm.

or acuminate-clavate, tholus J+ blue (Figure 13). *Ascospores* numerous (± 100 or more), simple, hyaline, ellipsoid, small, 5–9 × 3,2–5,2 μm. *Pycnidia* not seen. *Chemistry*: divaricatic acid only.

This is a unique new species of *Maronea*, because the apothecia are lecideine and the thallus is saxicolous, whereas all other species of *Maronea* known up to now have lecanorine apothecia and are corticolous. The lecanorine condition is characterized by a very reduced proper exciple and a well developed thalline exciple, not always in a protruded state. Oberhollenzer & Wirth (1984) treated several types of exciples in a single octosporous genus, *Fuscidea* V. Wirth & Vězda. The species with sunken apothecia and reduced exciples could be considered to have lecanorine apothecia, e.g. *Fuscidea atlantica* (Magn.) James & Poelt, originally described as a *Lecanora*. In a similar vein, Hertel (1984) has treated several lichens with *Lecanora*-type ascus apices, and curved acrogenous pycnidiospores with lecideine exciples, as species of *Lecanora* rather than of *Lecidea*, as would have been done in the past. The creation of a new genus for this lichen, therefore, seemed unwarranted.

Under the old system of classification of lichens, this species would key out at *Sarcogyne* Fw. (Magnusson 1935; Poelt 1969; Zahlbruckner 1926), but this genus often has a poorly developed thallus (mostly cryptothalline), and the exciple is of a different structure and is dark brown to carbonized in colour. The paraphyses in *Sarcogyne* are ecapitate and strongly gelled, unlike the loose capitate paraphyses of *Maronea afroalpina*, and *M. constans* (Nyl.) Hepp, the type of *Maronea* (Hafellner 1984).

The major difference, the one which places *Sarcogyne* and *Maronea* in two different families, is the ascus apex, which is amply illustrated in Figure 2 and by Hafellner (1984) for *Maronea*, and by Brusse (1987, 1988) for the Acarosporaceae, of which *Sarcogyne* is a typical member.

It is as well to state here, that several species of *Maronea* [section *Pseudomaronea* (Müll. Arg.) Magn.], treated by Magnusson (1934), such as *Lecanora crassilabra* Müll. Arg., have *Lecanora*-type ascus apices, and are not true *Maronea* species.

Maronea afroalpina Brusse is presently known only from high altitudes in the Drakensberg, at Mont-aux-Sources.

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F. BRUSSE

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COMBRETACEAE

A NEW SPECIES OF *COMBRETUM* FROM NATAL

Combretum mkuzense *Carr & Retief*, sp. nov., a *C. kirkii* Laws. frutice semi-scandenti ramulis terminalibus rigidis nec sinuosis, inflorescentiis puberulis differt.

TYPE.—Natal, 2732 (Ubombo): Mkuze Game Reserve headquarters (–CA), *Carr 187* (PRE, holo.; K).

Large shrub up to 5 m tall, widely spreading (to 12 m) with many near-horizontal lateral branches with apices sometimes twining; bark mainly smooth, pale buff-coloured with longitudinal reticulation and occasionally with dark grey bands, flaking; young branchlets light green, glabrous to sparsely puberulous and lepidote. *Leaves* opposite, exstipulate, petiolate; lamina elliptic to oblong-elliptic, (30–)45(–80) × (15–)20(–30) mm, base rounded, apex obtuse or occasionally retuse, slightly discolorous, upper surface deep green, glabrous except for scales, sometimes with a few cilia at the base, veins slightly immersed, lower surface paler green, glabrous except for scales and a few trichomes on the midrib, hairy pockets sometimes present, 5–7 pairs of lateral veins raised; petioles 4–9 mm long, lepidote, puberulous. Scales 45–85 μm in diam., 8-celled with a number of tangential walls. *Inflorescence* a spike, up to 25 mm long, singly or in pairs at the apices of previous year's growth and in axils on current extensions; peduncle and rhachis light green, sparsely puberulous, densely lepidote. *Flowers* sessile, 4-merous; bracteoles ± 0,5 mm long, lepidote; lower receptacle 2–2,3 mm long including restriction at junction with upper receptacle, brownish green, sparsely puberulous with dense yellowish stalked scales; upper receptacle cupuliform, surrounding the disc, distal portion infundibuliform, overall length ± 3 mm, width at sepal apices ± 3 mm, green, sparsely puberulous with whitish scales. *Sepals* triangular, ± 0,8 mm long, apices fringed with short whitish hairs. *Petals* 4, pale green, spathulate, glabrous, ± 1,5 mm long. *Stamens* 8; filaments light green, 6–6,5 mm long; anthers light yellow, 1 mm long.

FIGURE 14.—*Combretum mkuzense* Carr & Retief, holotype in PRE.

Style light green, ± 3,5 mm long with stigma slightly expanded and darkened. *Disc* square in outline with long silvery hairs. *Fruit* 4-winged, up to 50 × 50 mm, outline subcircular with a wide shallow basal notch and a small apical notch, apical peg up to 1 mm long, lepidote, stipe up to 20 mm long, densely lepidote; wings brown-tinged limegreen when ripening, cinnamon when ripe. *Seed* ellipsoidal, up to 16 × 9 mm, dark purplish brown. *Cotyledons* 2, up to 33 × 45 mm, transversely elliptic, arising above soil level; petioles ± 3 mm long. Figure 14.

NATAL.—2632 (Bella Vista): 15 km ENE of Makane's Drift (–CD), *Stephen 717* (PRE). 2732 (Ubombo): 3 miles W of Sihangwane store (–AA), *Moll 5370* (PRE); 1 mile E of Pongola pont (–AB), *Strey & Moll 3778* (PRE); Mkuze Game Reserve (–CA), *White 10388* (FHO, PRE); eastern side of farm 'Shotton 13810' (–CD), *Ward 8793* (PRE).

Combretum mkuzense, which is evidently rare, occurs in the northernmost part of Natal. It is found in mixed woodland in association with other combretaceous species, *Acacia, Sclerocarya, Strychnos, Dialium, Newtonia* and *Albizia*. It grows in deep sand at altitudes of up to 100 m and within 60 km of the coast.

C. mkuzense normally flowers in September but a second flowering late in March has also been recorded. The flowers are sweetly scented and appear to be bee-pollinated.

C. mkuzense is placed in the subgenus *Combretum*, section *Macrostigmatea*. According to Exell (1978) this section comprises three species, namely *C. schumannii*, *C. kirkii* and *C. gillettianum*. The section can be divided into two subsections on the basis of the disc, which is glabrous with only a very short free margin in *C. schumannii* and with a pilose margin free for ± 1 mm in *C. kirkii* and *C. gillettianum*. *C. mkuzense* has a disc with a pilose margin and is therefore thought to be more closely related to *C. kirkii* and *C. gillettianum* and to *C. schumannii* (Table 1).

C. mkuzense is most closely allied to *C. kirkii*. There are, however, several differences between the two species. The seeds of *C. kirkii* are as large as 25 × 9 mm while the seeds of *C. mkuzense* seen did not exceed 16 × 9 mm. Unlike the new species which has a peduncle and rachis sparsely puberulous and densely lepidote, the inflorescence of *C. kirkii* is glabrous except for the scales. Habit differences clearly separate these two species. *C. kirkii* is a liane with slender, sinuous, flexible, readily damaged apices many of which die back in winter. *C. mkuzense* is a scrambling shrub with numerous characteristic elongated lateral branches taking off in opposite pairs and at right angles. These branches are fairly straight and maintain appreciable rigidity right up to the apices but sometimes the apices may twine. It has been established, using thin film chromatography, that for each species of *Combretum* there is a characteristic profile of compounds in the leaf material (Carr & Rogers 1987). An examination of the profiles of *C. mkuzense* and *C. kirkii* shows similarities but also a significant difference.

Fruits of *C. zeyheri*, a tree which occurs in the same area as the new species, are similar to those of *C. mkuzense* but the habits of the two species differ so widely that they should not be easily confused. *C. zeyheri* is a small to medium-sized tree while *C. mkuzense* is a scrambling shrub. The scales of the new species (Figure 15) agree well with those of other representatives of the section *Macrostigmatea*. They differ markedly from those of *C. xanthothyrsum* (sect. Chionanthoideae) (Figure 16) a species which has sometimes been confused with our species.

TABLE 1.—A comparison of *Combretum mkuzense, C. kirkii* and *C. gillettianum*. Based partly on Exell (1978)

Characters	Species		
	C. mkuzense	*C. kirkii*	*C. gillettianum*
Habit	large shrub up to 5 m high, widely spreading with many near-horizontal lateral branches	liane, reaching 15 m	shrub to small tree up to 4 m high, sometimes scandent
Lateral nerves	5–7 pairs	5–7 pairs	3–5 pairs
Bracteoles	0,5 mm long	0,7 mm long	1,5 mm long
Lower receptacle	2–2,3 mm long, densely lepidote, sparsely puberulous	2–3 mm long, lepidote otherwise glabrous	2–2,5 mm long, tomentellous
Upper receptacle	3 × 3 mm, cupuliform in upper part then infundibuliform, puberulous and lepidote	3–4 × 2–3 mm, infundibuliform, lepidote otherwise glabrous	3,5–4 × 3–4 mm, cupuliform, appressed pubescent with 4 tomentellous nerves running up into the sepals
Fruit	up to 50 × 50 mm, subcircular	up to 50 × 50 mm, subcircular to elliptic	up to 30 × 25 mm, oval to subcircular, wings decurrent at the base
Stipe	up to 20 mm long	up to 30 mm long	up to 12 mm long
Distribution	northern Natal	Zambia, Zimbabwe, Malawi and Mozambique (confined to the valley of the Zambezi and its tributaries)	Zambia, Zaire and Tanzania

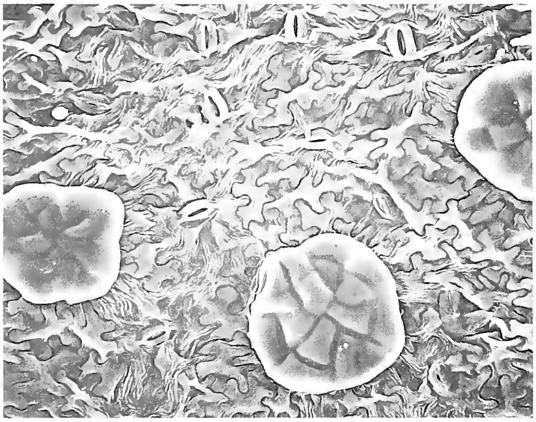

FIGURE 15.—Scales on the leaf surface of *Combretum mkuzense* Carr & Retief, × 360. *Carr 187*. Scanning electron micrograph taken at the Royal Botanic Gardens, Kew.

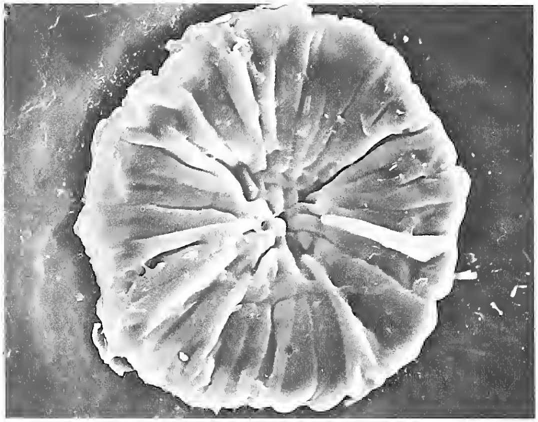

FIGURE 16.—A scale on the leaf surface of *Combretum xanthothyrsum* Engl. & Diels, × 600. *Proctor 2759*. Scanning electron micrograph taken at the Royal Botanic Gardens, Kew.

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Leaf anatomy of the South African Danthonieae (Poaceae). XVIII. *Centropodia mossamedensis*

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Keywords: *Centropodia mossamedensis*, C_4, Danthonieae, Kranz, leaf anatomy, Poaceae

ABSTRACT

The leaf blade anatomy of *Centropodia mossamedensis* (Rendle) T. A. Cope [= *Asthenatherum mossamedense* (Rendle) Conert] is described and illustrated. This description is based on freshly fixed material and confirms that this species has Kranz anatomy with the C_4 photosynthetic pathway. The anatomy differs little from that of *C. glauca* and both undoubtedly belong to the same genus which is justifiably separated from the other danthonoid genera.

UITTREKSEL

Die blaaranatomie van *Centropodia mossamedensis* (Rendle) T. A. Cope [= *Asthenatherum mossamedense* (Rendle) Conert] word beskryf en geïllustreer. Hierdie beskrywing is gebaseer op vars gefikseerde materiaal en bevestig dat hierdie spesie die Kranz-tipe anatomie en C_4-fotosintese besit. Die blaaranatomie wyk weinig af van dié van *C. glauca* en albei spesies behoort ongetwyfeld aan dieselfde genus. Hierdie studie bevestig dat *Centropodia* van die ander genera in die Danthonieae geskei behoort te word.

INTRODUCTION

In a previous paper (Ellis 1984) in this series the anatomy of *Centropodia mossamedensis* (Rendle) T. A. Cope [= *Asthenatherum mossamedense* (Rendle) Conert] (Cope 1983) was briefly described. This description was based on herbarium material and the anatomical preparations were not of a very high quality. Subsequent to the above study, fresh material of *C. mossamedensis* was collected and fixed in the field, yielding good quality leaf blade transverse sections. The results are described, illustrated and compared with the leaf anatomy of *C. glauca* (Nees) T. A. Cope [= *Asthenatherum glaucum* (Nees) Nevski].

MATERIALS AND METHODS

Plants of *C. mossamedensis* were collected in South West Africa/Namibia. Herbarium voucher specimens were prepared for verification by the National Herbarium (PRE) where they are now housed.

Leaf blade segments were removed and immediately fixed in FAA. Leaf blade transverse sections and abaxial epidermal scrapes were prepared following the methods outlined in a previous paper in this series (Ellis 1988).

The standardized terminology of Ellis (1976, 1979) was used for the anatomical descriptions together with the following abbreviations:

vb/s — vascular bundle/s
1'vb/s — first order vascular bundle/s
2'vb/s — second order vascular bundle/s
3'vb/s — third order vascular bundle/s
ibs — inner bundle sheath; mestome sheath
obs — outer bundle sheath; parenchyma sheath

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Specimens examined:

Centropodia mossamedensis

SWA/NAMIBIA.—2014 (Welwitschia): Damaraland, 60 km W of Khorixas on road to Skeleton Coast (–AB), *Ellis 4750*. 2116 (Okahandja): Okahandja Dist.; 26 km W on road to Swakopmund, Otjitundu River crossing (–DD), *Ellis 4725, 4726*.

ANATOMICAL DESCRIPTION OF *CENTROPODIA MOSSAMEDENSIS*

Leaf in transverse section

Leaf outline: expanded and flat lamina (Figure 1A & E). *Ribs and furrows*: very slight adaxial ribs (Figure 1B & F); slight furrows between all vbs; ribs rounded. Abaxial ribs and furrows more pronounced than adaxial ones (Figure 1B & F); furrows between all vbs and ribs rounded. *Median vascular bundle*: structurally indistinguishable from lateral 1'vbs. *Vascular bundle arrangement*: 9 or 13 1'vbs in leaf section: 3, 4 or 5 3'vbs between consecutive 1'vbs except laterally where fewer 3'vbs are present (Figure 1A & E); 2'vbs absent; all vbs centrally located in blade. *Vascular bundle structure*: 3'vbs slightly elliptical with well developed xylem and phloem tissue and an ibs (Figure 1B, C & F); 1'vbs elliptical (Figure 1B, C & F); phloem adjoins the ibs; metaxylem vessels narrow, with a diameter slightly less than that of the obs cells; diameter greater than that of the ibs cells. *Vascular bundle sheaths*: double; slightly elliptical to almost rounded; both sheaths entire around all vbs (Figure 1C); no extensions although a few Kranz cells may be located outside the outer sheath (Figure 1C); parenchyma sheath cells very numerous (15–26), regular in size and shape, fan-shaped with straight radial walls and inflated outer tangential walls; specialized, large, centripetally situated chloroplasts conspicuous; ibs complete around 1' and 3'vbs; cells with slight secondary thickening. *Sclerenchyma*: small adaxial girders associated with all 1'vbs and strands with the 3'vbs; taper toward the bundles; similar abaxial girders and strands

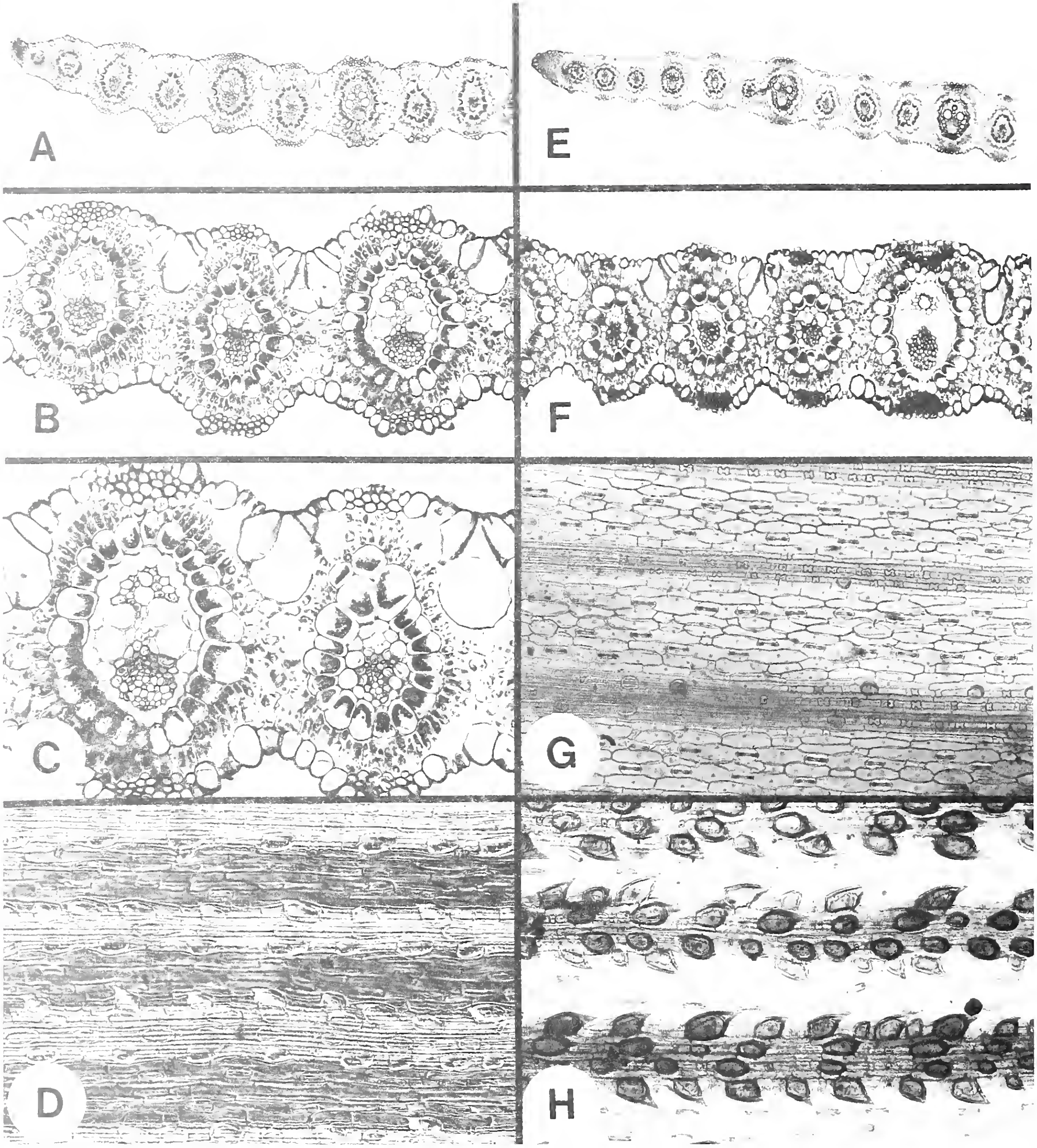

FIGURE 1.—Leaf anatomy of *Centropodia mossamedensis*. A–D, *Ellis 4726*: A, outline of flat, expanded blade, × 100; B, transectional anatomy, × 250; C, anatomical detail showing Kranz anatomy with centripetal specialized parenchyma sheath chloroplasts, × 400; D, abaxial epidermis with costal prickles and intercostal stomata, interference contrast, × 250. E–G, *Ellis 4750*: E, blade outline, × 100; F, Kranz transectional anatomy, × 250; G, abaxial epidermis with few costal prickles, × 250. H, *Ellis 4725*, abaxial epidermis with well developed prickles and intercostal microhairs, × 250.

associated with all vbs except that strands sometimes also associated even with 1'vbs (Figure 1B & C); fibres thick-walled (Figure 1F) or thin-walled (Figure 1B & C) but never lignified. No sclerenchyma between bundles. Small sclerenchyma cap in margin. *Mesophyll*: radiate chlorenchyma (Figure 1B, C & F); single layer of tabular cells surround bundles completely (Figure 1B & C) or with small interruptions due to girders (Figure 1F); lateral cell count 2 or 3. No colourless cells associated with the bulliform cells. *Adaxial epidermis*: fan-shaped bulliform cell groups with central cell shield-shaped; occupy less than half the leaf thickness; epidermal cells with slightly thickened outer walls; macrohairs not present; small costal hooks present (Figure 1B) or absent (Figure 1F); no papillae. *Abaxial epidermis*: small bulliform-like cells at bases of furrows; macrohairs absent; costal prickles present (Figure 1B) or absent (Figure 1F); no papillae.

Abaxial epidermis in surface view

Intercostal long cells: elongated with side walls almost parallel (Figure 1D) to inflated, fusiform (Figure 1G); walls not sinuous; cells adjoin one another or sepa-

rated by short cells or stomata. *Stomata*: low dome-shaped (Figure 1D & G); not in regular files and occur in most long cell files; 1 or 2 interstomatal cells between successive stomata in a file. *Intercostal short cells*: absent or very rare (Figure 1D) or irregular (Figure 1G); no cork or silica cells but just very short epidermal cells. *Papillae*: absent. *Prickles*: costal, either very common (Figure 1D & H) or rare (Figure 1G); barbs either well developed or virtually absent. *Hooks*: absent. *Microhairs*: present on all specimens but rare (Figure 1H); both cells elongated but distal cell not tapering to a pointed apex; two cells about equal in length. *Macrohairs*: absent. *Silica bodies*: variable, irregular dumbbell-shaped (Figure 1G), short and narrow (Figure 1H) or horizontally elongated rectangular (Figure 1D); occur throughout costal zones; sometimes associated with cork cells but often not.

DISCUSSION AND CONCLUSIONS

The transectional leaf anatomy compares very closely with that of *C. glauca* (Ellis 1984). Both are undoubtedly Kranz with radiate mesophyll, and no chlorenchyma cells are more than one cell distant from a Kranz cell. This indicates the presence of the C_4 photosynthetic pathway which is confirmed by a $12_C/13_C$ ratio of $-12{,}6$ $^0/_{00}$ *(De Winter & Hardy 8021)*. The outer bundle sheath has a regular outline and is Kranz with centripetally located specialized chloroplasts. This structure is typical of that characteristic of the NAD-me subtype of the C_4 photosynthetic pathway but this has yet to be confirmed as *Centropodia* has not yet been biochemically typed (Hattersley 1987).

Anatomical differences between *C. mossamedensis* and *C. glauca* are only minor, particularly the leaf in transverse section. Vessel element diameter is proportionally greater in *C. mossamedensis* where they are slightly wider than the inner bundle sheath cells but they are, nevertheless, still relatively narrow. The bulliform cells occupy less than half the leaf thickness in *C. mossamedensis* but in *C. glauca* they are equal to at least half the leaf thickness. In transection no elongated prickle hairs are evident as in many *C. glauca* specimens.

Superficially the abaxial epidermis differs considerably from that of *C. glauca*. No interlocking prickles resembling macrohairs are present and the unique macrohairs with corrugated cell walls, as in *C. glauca* var. *lasiophyllum*, were not observed.

These epidermal differences are visually very striking but it must be remembered that *C. glauca* exhibits continuous anatomical variation from those specimens with conspicuous interlocking prickle hairs to specimens without this hair type (Ellis 1984). This variation pattern is associated with an ecological cline from the extremely arid Namib Desert eastward to the Kalahari. The anatomy of *C. mossamedensis* appears to be a northward expression of this cline along a moisture gradient and *C. mossamedensis* may merely represent a continuation of this reduction trend evident in *C. glauca*.

The two species are distinct morphologically (Conert 1962) and also appear to occupy different niches. *C. glauca* is a species of the loose red sands of the Kalahari dunes whereas *C. mossamedensis* is confined to gravelly or coarse waterborne sands in dry watercourses. Their separation at species level is, therefore, not questioned by this study even though these two species do not exhibit significant leaf anatomical differences.

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Kranz distinctive cells in the culm of *Arundinella* (Arundinelleae; Panicoideae; Poaceae)

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Keywords: anatomy, *Arundinella*, C_4, culm, distinctive cells, double bundle sheath, NADP-me

ABSTRACT

The transectional anatomy of photosynthetic flowering culms of *Arundinella berteroniana* (Schult.) Hitchc. & Chase and *A. hispida* (Willd.) Kuntze from South America and *A. nepalensis* Trin. from Africa is described and illustrated. The vascular bundles are arranged in three distinct rings, the outermost being external to a continuous sclerenchymatous band. Each of these peripheral bundles is surrounded by two bundle sheaths, a complete mestome sheath and an incomplete, outer, parenchymatous Kranz sheath, the cells of which contain large, specialized chloroplasts. Kranz bundle sheath extensions are also present. The chlorenchyma tissue is also located in this narrow peripheral zone and is interrupted by the vascular bundles and their associated sclerenchyma. Dispersed throughout the chlorenchyma are small groups of Kranz distinctive cells, identical in structure to the outer bundle sheath cells. No chlorenchyma cell is, therefore, more than two cells distant from a Kranz cell. The structure of the chlorenchyma and bundle sheaths indicates that the C_4 photosynthetic pathway is operative in these culms.

This study clearly demonstrates the presence of the peculiar distinctive cells in the culms as well as in the leaves of *Arundinella*. Also of interest is the presence of an inner bundle sheath in the vascular bundles of the culm whereas the bundles of the leaves possess only a single sheath. It has already been shown that *Arundinella* is a NADP-me C_4 type and the anatomical predictor of a single Kranz sheath for NADP-me species, therefore, either does not hold in the culms of this genus or the culms are not NADP-me. This is only the second reported breakdown of this association between MS anatomy and the NADP-me biochemical C_4 type.

UITTREKSEL

Die anatomie van dwarssneë van fotosintetiese bloeiwysehalms van *Arundinella berteroniana* (Schult.) Hitchc. & Chase en *A. hispida* (Willd.) Kuntze vanaf Suid-Amerika en *A. nepalensis* Trin. van Afrika word beskryf en geïllustreer. Die vaatbondels is in drie duidelike ringe gerangskik, met die buitenste vaatbondels aan die buitekant van 'n aaneenlopende sklerenchiemband. Hierdie periferale vaatbondels word elk omring deur twee vaatbondelskedes, 'n volledige mestoomskede en 'n onvolledige, buitenste parenchiematiese Kranz-skede waarvan die selle groot, gespesialiseerde chloroplaste bevat. Kranz-verlengings van die bondelskede is ook teenwoordig. Chlorenchiemweefsel is ook teenwoordig in hierdie smal periferale sone en word onderbreek deur die vaatbondels en hul meegaande sklerenchiem. Klein groepies Kranz-kenmerkende selle wat struktureel identies is aan die buitenste vaatbondelskedeselle is deur die chlorenchiem versprei. Geen chlorenchiemsel is dus meer as twee selle van 'n Kranz-sel verwyder nie. Die struktuur van die chlorenchiem en die vaatbondelskede dui aan dat die C_4- fotosintetiese weg in die halms gevolg word.

Hierdie studie toon duidelik die teenwoordigheid van die unieke kenmerkende selle in beide die halms en blare van *Arundinella*. Ook opvallend was die teenwoordigheid van 'n binneste vaatbondelskede in die vaatbondels van die halm, terwyl die vaatbondels van die blare slegs 'n enkele skede besit. Daar is reeds getoon dat *Arundinella* 'n NADP-me C_4- tipe is, en die anatomiese aanwyser van 'n enkele Kranz-skede vir NADP-me-spesie is dus òf nie van toepassing op die halms van hierdie genus nie òf die halms is nie NADP-me nie. Hierdie is slegs die tweede bevestiging van 'n NADP-me biochemiese C_4- tipe sonder MS anatomie.

INTRODUCTION

Some species of *Arundinella* Radii are characterized by the presence of Kranz distinctive cells in the mesophyll of the leaf blades. *Arundinella* is a C_4 genus which possesses the Kranz syndrome (Brown 1977) and these distinctive cells are very similar to those of the Kranz mestome sheath which surrounds the vascular bundles (Brown 1975). The distinctive cells have thicker walls than those of the radially arranged chlorenchyma cells between which they are embedded (Carolin *et al.* 1973) and these walls also stain heavily. They contain abundant specialized chloroplasts which store starch (Brown 1975; Renvoize 1982a). In transection they occur either singly between the vascular bundles or are found in groups of two to six cells without accompanying vascular tissue.

Some authors are of the opinion that the distinctive cell files connect with the parenchyma sheath cells (Carolin *et al.* 1973; Ellis 1977). However, in paradermal view it is evident that they are not continuous with the vascular tissue but are contiguous isolated Kranz cell strands that lie parallel to the vascular bundles and are not in contact with them (Crookston & Moss 1973). They are presumably functionally linked to the vascular bundles at intervals by cross veins (Crookston & Moss 1973; Crookston 1980; Renvoize 1982a). Where the cross veins traverse strands of distinctive cells some of these Kranz cells become appressed to the cross vein, so forming a functional link with the vascular tissue.

These cells were first reported by Vickery (1935) in the leaf blade transection of *A. nepalensis* Trin. Tateoka

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TABLE 1.—Historical review of the study of Kranz distinctive cells in grass leaf blades

Taxon	Terminology	Reference
Arundinella nepalensis	Thick-walled cells resembling isolated bundle sheath cells	Vickery 1935
Arundinella hirta	Characteristic cells containing many chloroplasts	Tateoka 1956
Garnotia stricta	Distinctive cells	Tateoka 1956a
Arundinella decempedalis *Trichopteryx fructiculosa*	Reduzierte tertiäre Bündel	Conert 1957
Arundinella nepalensis, A. holcoides, A. birmanica, A. decempedalis, A. bengalensis, A. leptochloa, A. purpurea *Garnotia stricta, G. tectorum, G. boninensis, G. acutigluma, G. fuscata, G. drymeia*	Distinctive cells	Tateoka 1958
Arundinella berteroniana	Similar to parenchyma sheath cells	Brown 1958
Arundinella metzii	Circular cells	Metcalfe 1960
Arundinella ecklonii	—	Jacques-Félix 1962
Arthropogon scaber, A. piptostachya	Distinctive cells	Tateoka 1963
Anthephora cristata	Distinctive cells	Johnson 1964
Arundinella fuscata, A. metzii, A. palmeri, A. spicata	Células redondeadas algo incoloras de estructura semejante a la de las células de la vaina parenquimatica	Türpe 1970
Garnotia spp.	Cells similar to bundle sheath cells	Gould 1972
Arundinella montana, A. berteroniana	Distinctive cells	Li & Phipps 1973
Arundinella nepalensis	Isolated parenchyma sheath cells	Carolin *et al.* 1973
Anthephora cristata	Distinctive cells	Johnson & Brown 1973
Arundinella hirta	Specialized parenchyma cells	Crookston & Moss 1973
Arundinella spp. *Arthropogon* spp. *Anthephora* spp. *Garnotia* spp.	Distinctive cells	Brown 1975
Arundinella nepalensis *Garnotia stricta*	Interveinal circular cells	Hattersley & Watson 1975
Anthephora spp. *Arthropogon* spp. *Arundinella* spp. *Loudetia* spp. *Trichopteryx* spp. *Garnotia* spp.	Distinctive cells	Brown 1977
Garnotia stricta	Circular cells	Clifford & Watson 1977
Arundinella nepalensis	Distinctive cells	Ellis 1977
Arundinella hirta	Specialized parenchyma cells	Reger & Yates 1979
Arundinella hirta	Isolated Kranz cells	Crookston 1980
Arundinella nepalensis	Distinctive cells	Hattersley & Browning 1981
Arundinella nepalensis	Auxillary bundle cells	Renvoize 1982
Garnotia stricta	Auxillary bundle cells	Renvoize 1982
Anthephora spp. *Arthropogon* spp. *Arundinella* spp. *Loudetia* spp. *Trichopteryx* spp. *Garnotia* spp.	Circular cells	Watson, Dallwitz & Johnston 1986
Arundinella spp. *Garnotia* spp.	Auxillary bundle cells	Clayton & Renvoize 1986

(1956b) was the first to designate these cells calling them distinctive cells. Subsequently various authors have used differing terminology and a historical review of the study and terminology of these cells is given in Table 1.

This tabulated summary (Table 1) shows that the term distinctive cells appears to be the most widely accepted for these structures and it will be used in this paper. However, the term distinctive cell does not convey the structure or function of these cells and the proposal of the term auxiliary bundle cells (Renvoize 1982a; Clayton & Renvoize 1986) has some merit since these cells undoubtedly are part of the photosynthetic system, being auxiliary photosynthetic strands. Hattersley *et al.* (1977) have

demonstrated that these cells are isolated photosynthetic carbon reduction (PCR, Kranz) strands embedded in the primary carbon assimilation (PCA) chlorenchyma tissue; and they exhibit NADP-me activity (Reger & Yates 1979). Ultrastructurally they are also seen to be similar to the Kranz mestome sheath cells. Both have large agranal chloroplasts containing numerous starch grains (Crookston & Moss 1973; Crookston 1980) and a suberized lamella is located in the cell walls (Hattersley & Browning 1981). The chloroplasts of the chlorenchyma cells, on the other hand, are free of starch and have well developed grana and the cell walls lack a suberized lamella. The distinctive cells are, therefore, undoubtedly Kranz cells and will be designated as such.

From Table 1 it can also be seen that distinctive cells have only been reliably reported in four genera belonging to four small tribes of the Panicoideae: *Arundinella* of the Arundinelleae (Tateoka 1956a, 1958); *Garnotia* of the Garnotieae (Tateoka 1956b, 1958); *Arthropogon* of the Arthropogoneae (Tateoka 1963) and *Anthephora* of the Anthephoreae (Johnson & Brown 1973). Watson *et al.* (1986) record 'circular cells' in nine genera of the Panicoideae. The reports of distinctive cells in *Trichopteryx* and *Loudetia* of the Arundinelleae (Brown 1977) appear to be misleading and probably refer to the very reduced vascular bundles surrounded by only three or four Kranz sheath cells which are known from these genera which also lack cross veins (Renvoize 1982a). Many authors have confirmed the occurrence of distinctive cells in *Arundinella* and *Garnotia* (Table 1) and *Arthropogon xerachne* (Sánchez & Arriaga 1988) but verification of their reported presence in *Anthephora* is required. We have examined leaves of 25 specimens of four species of *Anthephora*, all of which have very small minor vascular bundles consisting of only three or four bundle sheath cells surrounding a minute vascular strand. Consequently we query the reported presence of distinctive cells in this genus. We have also examined leaves of *Tristachya lejostachya* and *Loudetia flammida* (Sánchez & Arriaga 1988), *L. pedicellata* and *L. simplex* (Ellis 1977) without detecting the presence of distinctive cells. In all these cases a few xylem vessels were detected in association with the Kranz cells but these are not considered to be distinctive cells.

Nevertheless, as presently known, distinctive cells are characteristic of and unique to these four small tribes of the Panicoideae and may indicate phylogenetic relationships between them. Johnson & Brown (1973) consider the possession of distinctive cells to be sufficient grounds for considering these four tribes as constituting one tribe or even a supertribe. *Garnotia* and *Arundinella*, in particular, are very closely related (Renvoize 1982b) and appear to constitute a distinct and related group of genera sharing this interesting anatomical feature, as well as spikelet characteristics. Distinctive cells are not a characteristic of the tribe Arundinelleae but are only a feature of some species of *Arundinella* (Renvoize 1982a).

The culms (aerial stems) of grasses display considerable anatomical variation but, in contrast to the leaf blade, have been poorly documented (Sabnis 1921; Canfield 1933; De Wet 1960; Metcalfe 1960; Auquier & Somers 1967). Some of these studies include members of the Arundinelleae. De Wet (1960) describes the peripheral vascular bundles of the culm of *Arundinella* as being surrounded by a parenchymatous bundle sheath composed of small cells. Auquier & Somers (1967) consider the anatomical structure of the culm of *Arundinella* as belonging to the 'panicoid type' with the peripheral bundles surrounded by a well developed parenchymatous sheath. None of these authors refer to the presence of Kranz anatomy in the cortical zone of the culm. Sánchez (1979, 1981a, 1981b, 1983a, 1983b, 1984) is the first worker to report the presence and development of Kranz anatomy in flowering and stoloniferous culms. Kranz anatomy is only developed in the upper exposed parts of flowering culms and not the basal parts which are covered by the leaf sheath (Sánchez 1981a); it is therefore essential to examine comparative material.

The objective of this study is to determine whether *Arundinella* exhibits Kranz structure in the flowering culm. If this is so then it will also be of interest to see whether distinctive Kranz cells are also present. This paper describes the structure and arrangement of these cells in the culms of three species of *Arundinella*: *A. berteroniana* (Schult.) Hitchc. & Chase and *A. hispida* (Willd.) Kuntze from Argentina and *A. nepalensis* from South Africa. *A. hispida* from the New World and *A. nepalensis* from the Old World appear to be closely related and Phipps (1967) included them both in the Nepalenses series which he considered to be central to the genus.

MATERIALS AND METHODS

Transverse and longitudinal sections of flowering culms were made from segments taken from the centre of the first internode below the inflorescence. Both herbarium and field collected material fixed in FAA was used. Sections were either free-hand or the material was desilicified, embedded in wax and sectioned on a rotary microtome. These sections were stained with Alcian Blue and Safranin (Cutler 1978) or Fast Green and Safranin (Johansen 1940). Uncleared sections were soaked in 5% NaOH for 5–10 minutes to restore turgidity and were then used to observe chloroplast position in the Kranz cells.

Material examined

A. berteroniana

BA 27/2263; *BA 18993*; *Giusti 1214* (BA); *Parodi 1781* (BA); *Vervoorst & Cuezzo 7731* (CTES).

A. hispida

BA 11258; *BA 16098*; *Schinini & Tressens 24545* (BA); *Schinini et al. 17348* (CTES); *Quarin 409* (CTES); *Schulz 3469* (CTES); *Royo 238* (CTES).

A. nepalensis

BAA 19752; *Ellis 479* (PRE 61722)*, *1218* (PRE 61723)*, *1368* (PRE 61724)*, *1436* (PRE 61725)*, *1481* (PRE 61726)*, *1617* (PRE 61727)*, *2116* (PRE 61728)*, *3358* (PRE 622413)*, *4977*.

ANATOMICAL DESCRIPTION OF THE CULM

The general shape of the sections is circular (Figures 1A; 2A, C & E; 3A; 4A) with a smooth or slightly undulating outline. The diameter of the transections was

* only leaf blade material examined.

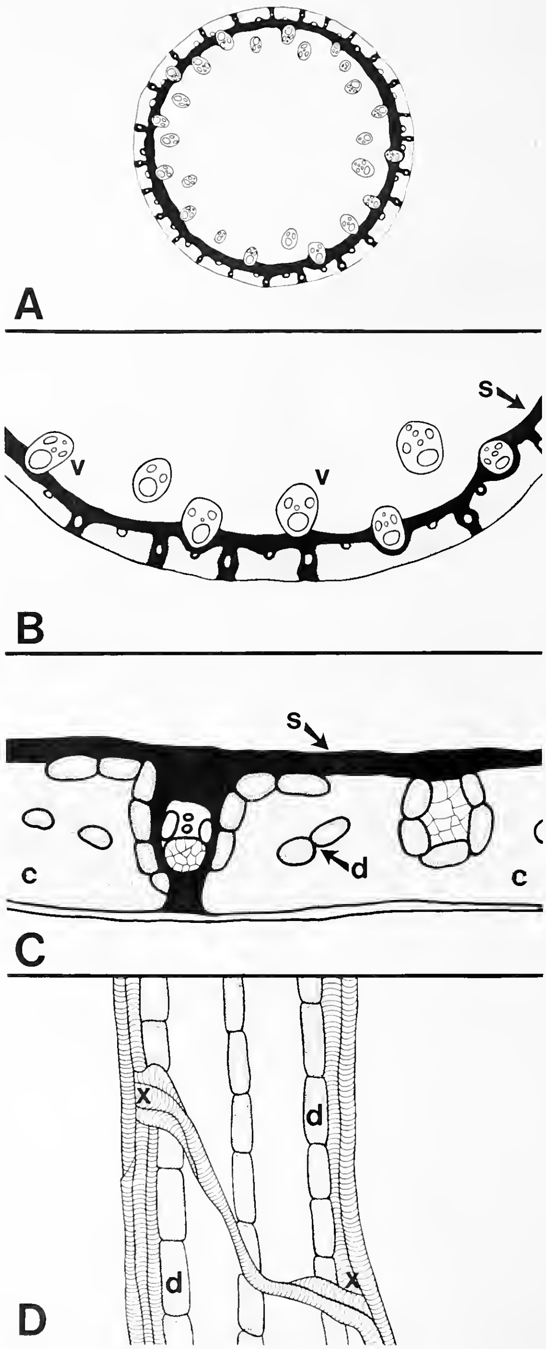

FIGURE 1.—Schematic diagrams of the culm anatomy of *Arundinella*. A, transection of the first internode of a flowering culm; B, transectional detail showing arrangement of vascular bundles (v) and the location of the sclerenchymatous ring (s); C, detail of the peripheral zone showing distinctive cells (d) in the chlorenchyma (c); D, paradermal longitudinal view of Kranz distinctive cells (d) with a transverse connection of xylem (x).

found to be ± 2 mm in *A. berteroniana* and *A. hispida* and ± 1,5 mm in *A. nepalensis*.

The epidermis is simple. Stomata were observed adjacent to the chlorenchyma zones and the subsidiary cells are at the same level as the epidermal cells (Figures 2D; 4C). No prickle hairs or hooks were observed.

A discontinuous ring of chlorenchyma is present below the epidermis. This ring consists of 1–6 layers of rachymorph cells none of which are more than two cells distant from a Kranz cell. This tissue is interrupted at regular intervals by the sclerenchyma girders of the peripheral vascular bundles (Figures 1B; 2B, D & F; 3C; 4B). This peripheral zone is narrow, occupying $^1/_{10}$–$^1/_{12}$ of the total diameter of the culm transection.

This peripheral chlorenchymatous zone is bounded internally by a continuous ring of sclerenchyma consisting of 1–3(–4) layers of lignified, fibrous cells (Figures 1B; 2B, D & F; 3C; 4B). This unicylindrical sclerenchymatous ring encloses the parenchymatous pith, the centre of which may be hollow (Figures 2A; 4A) or not (Figures 2C; 3A).

The vascular bundles are arranged in 3(–6) distinct circles or rings and are alternately spaced (Figures 1A; 2A, C & E; 3A; 4A), although rarely 4 or 5 circles of bundles are present. The bundles can be divided into two types: peripheral bundles and non-peripheral bundles.

The peripheral vascular bundles are external to the sclerenchymatous ring and occur in two distinct size classes. The larger first or second order bundles with metaxylem vessels are partially attached to the sclerenchyma ring and are linked to the epidermis by sclerenchyma girders (Figures 1C; 2B, D & F; 3C; 4B). These bundles are surrounded by two bundle sheaths, a complete mestome sheath and an incomplete Kranz parenchyma sheath (Figures 1C; 2B & D; 4C). Bundle sheath extensions of the latter sheath may extend along the outer surface of the sclerenchymatous ring for a distance of from 2–3 cells (Figures 1C; 4C). Some of the larger bundles may exhibit a partial or complete periphloematic sheath (Caro 1961). The smaller third order peripheral bundles without metaxylem vessels do not have sclerenchyma girders attaching them to the epidermis (Figures 1C; 2F; 4C). These bundles are surrounded by only a single incomplete Kranz parenchyma sheath, interrupted where it adjoins the sclerenchymatous ring. These smaller bundles may also possess bundle sheath extensions.

Distinctive Kranz cells are present in the peripheral zone (Figures 1C; 2B; 4B & C). These cells are similar in structure to the Kranz parenchyma sheath cells of all the vascular bundles of this zone. They have thicker walls and larger, predominately centrifugally located chloroplasts than do the chlorenchyma cells and are found singly or in groups of 1–3(–4) without associated xylem or phloem cells.

In paradermal view the Kranz distinctive cells form long rows, 1 or 2 cells wide, that lie parallel to the vascular bundles but are not accompanied by vascular tissue (Figure 1D). They are connected by lateral crossveins which traverse from one vascular bundle to another. These interconnections consist only of xylem elements and they are not accompanied by bundle sheath cells. No phloem cells were seen. Interconnections are relatively common in the chlorenchymatous zone in the culms of *Arundinella*.

A second and third (seldom a fourth or fifth) circle of collateral vascular bundles is situated on the inner side of

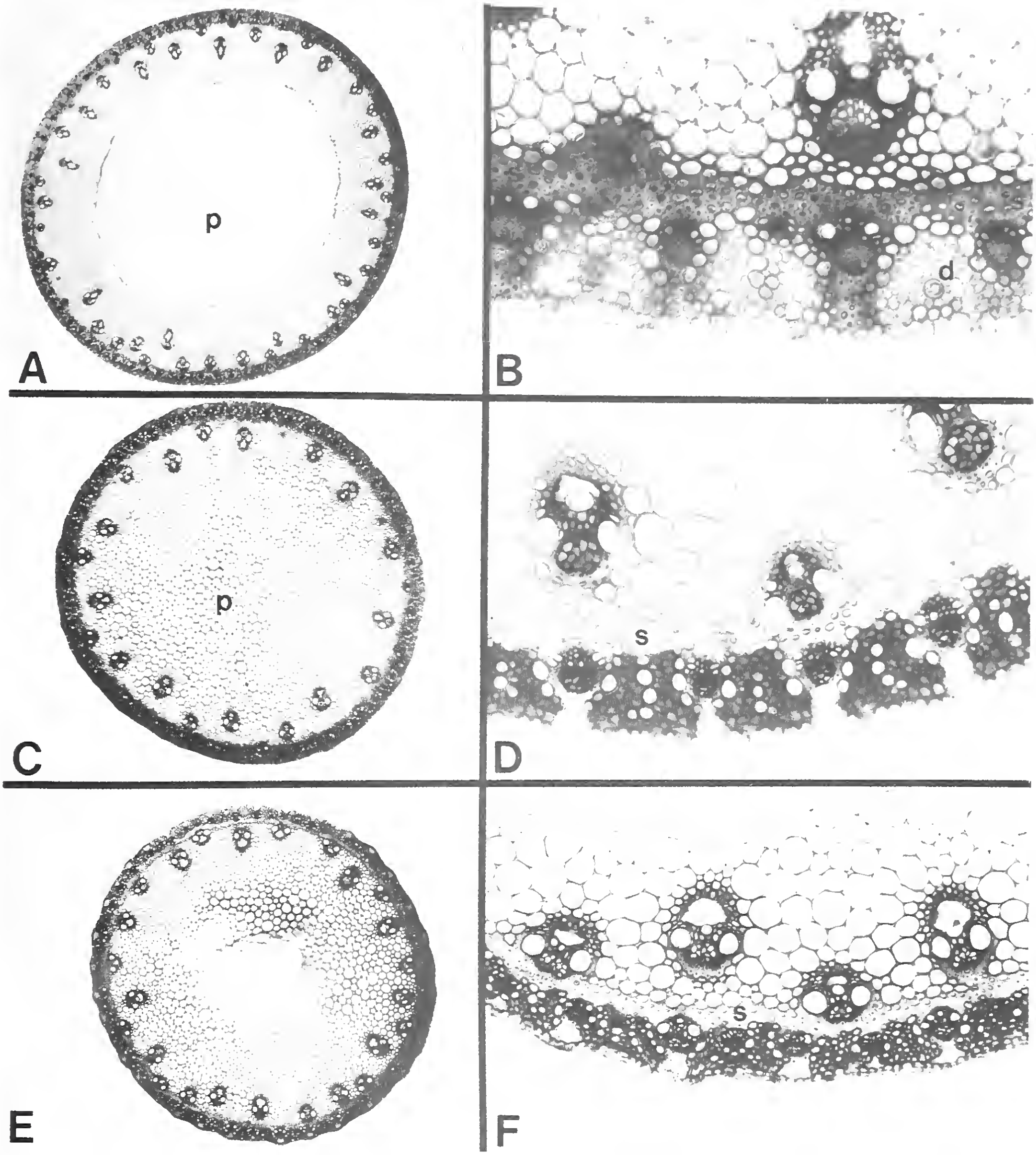

FIGURE 2.—Culm anatomy of *Arundinella hispida* as seen in transverse section. A–B, *Schinini & Tressens 24545*: A, culm outline with hollow pith (p), × 50; B, peripheral zone with vascular bundles, chlorenchyma and distinctive cells (d) external to the continuous sclerencyma ring (s), × 400. C–D, *Schinini et al. 17348*: C, culm outline showing solid pith (p), × 50; D, detail of peripheral Kranz tissue with distinctive cells in the chlorenchyma external to the sclerenchyma ring (s), × 400. E–F, *BA 11258*: E, culm outline, × 50; F, detail of peripheral zone with external vascular bundles, the sclerenchyma ring (s) and interal vascular bundles in the pith, × 250.

the sclerenchymatous ring. The second circle is partially embedded in these fibres but the other circles are located in the parenchymatous ground tissue of the pith. These inner two circles of bundles consist only of larger, first order vascular bundles surrounded by a single mestome sheath (Figures 1B; 2B, D & F; 3B, C; 4B).

DISCUSSION AND CONCLUSIONS

The presence of these rare and specialized Kranz distinctive cells has previously been confirmed in only two genera, *Arundinella* and *Garnotia*. However, there has been much confusion in the literature regarding the terminology for these cells (Table 1) and, although Watson *et al.* (1986) record circular cells in nine genera, it is not clear whether these are all homologous with the particular cells described here. This situation is confusing and unsatisfactory and it is proposed that the term Kranz distinctive cells should in future be employed only for isolated groups of, or single, Kranz cells in the mesophyll which are not associated with contiguous vascular tissue. The term distinctive cells enjoys historical precedent (Tateoka 1956b) and Kranz distinctive cells also gives an indication of their function. Furthermore this designation is explicit even when translated into other

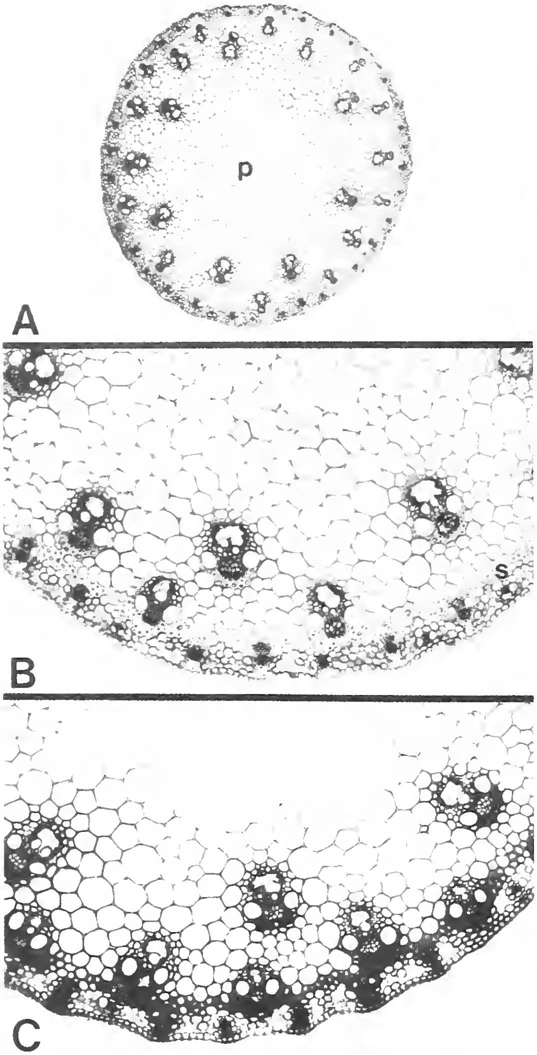

FIGURE 3.—Transectional culm anatomy of *Arundinella berteroniana, Giusti 1214*. A, outline of culm with solid pith (p), × 100; B, detail of peripheral zone with internal vascular bundles, sclerenchymatous ring (s) and outermost Kranz zone, × 250; C, outer, peripheral zone showing darkly stained, thickened lignified tissue of the mestome sheaths, sclerenchyma girders and the sclerenchyma ring, × 250.

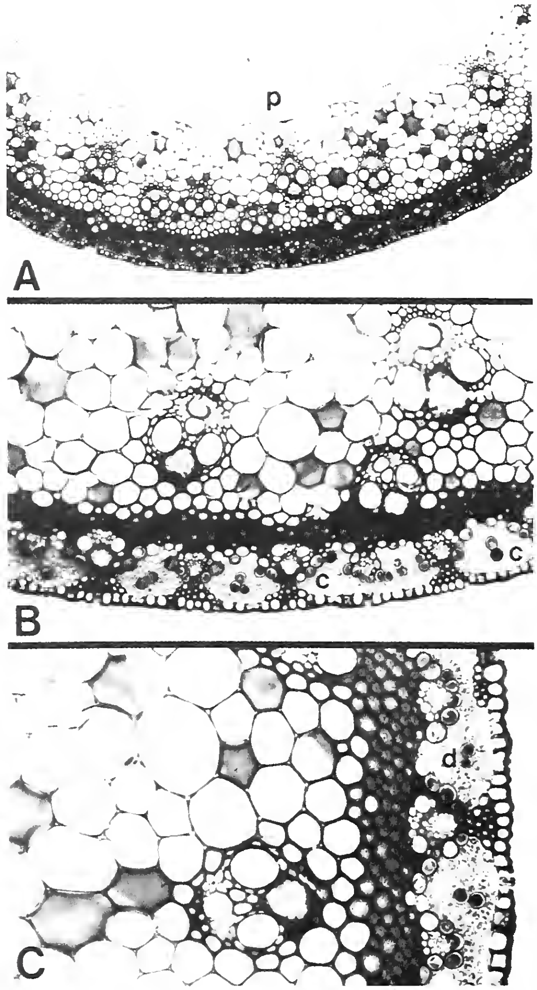

FIGURE 4.—Culm anatomy of *Arundinella nepalensis, Ellis 4977*. A, hollow pith (p) with two rings of vascular bundles in the outermost pith layers, × 100; B, peripheral zone showing inner vascular bundles, sclerenchyma ring and chlorenchyma tissue (c) interrupted by outer ring of Kranz vascular bundles, × 250; C, detail of chlorenchyma, distinctive cells (d), Kranz outer bundle sheath and sheath extensions, inner mestome sheath and sclerenchyma ring, × 400.

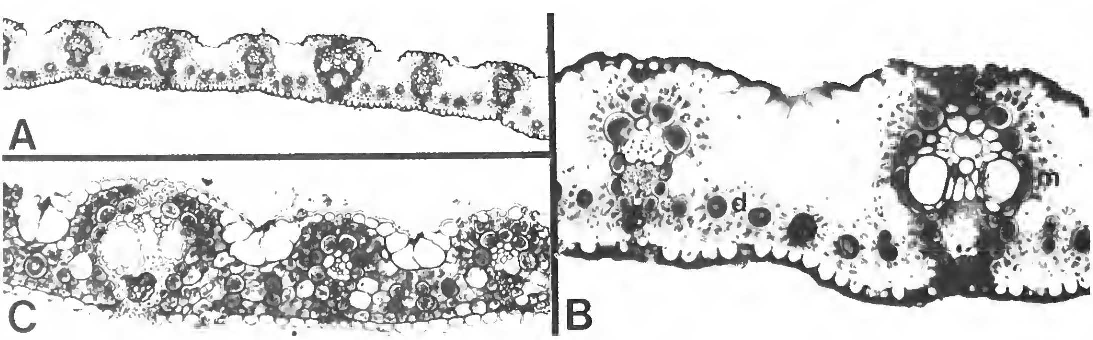

FIGURE 5.—Leaf blade anatomy of *Arundinella* in transverse section. A–B, *A. nepalensis*: A, distribution of distinctive cells in the chlorenchyma between all vascular bundles, *Ellis 1481*, × 100; B, anatomical detail of distinctive cells (d) and single, Kranz vascular bundle sheath (m), *Ellis 1617*, × 400. C, *A. berteroniana* with distinctive cell groups dispersed in the chlorenchyma tissue, *Davidse 32217*, × 400.

languages. Standardization on this most commonly used terminology should ensure the elimination of any future misunderstanding.

This study has clearly shown that the unique Kranz distinctive cells of the leaf blades of *Arundinella* (Figure 5A, B & C) also occur in the photosynthetic culms. In culm transections they are seen to be rounded cells with thickened walls which contain specialized chloroplasts. They are distinctly larger than the chlorenchyma cells in which they are embedded. These distinctive cells occur as isolated groups or strands in the chlorenchyma comprising one to three contiguous Kranz cells without accompanying vascular tissue. In paradermal view it is clear that they do not form part of the vascular tissue and, therefore cannot be considered as degenerate intercalary vascular bundles (Brown 1977). Instead they are seen to be long, isolated Kranz cell columns not physically connected to the vascular bundles but presumably functionally linked at regular intervals by vascular strands. This structure is virtually identical to that described for the distinctive cells of the leaf blades of several *Arundinella* species. There can be no doubt that these cells which are reported here in the culms of *Arundinella* for the first time, represent homologous structures in leaf blades and photosynthetic culms. The occurrence of Kranz anatomy in both culms and leaves is noteworthy, because grass species with Kranz leaf anatomy do not necessarily exhibit Kranz structure in the culm as well (Sánchez unpublished).

The fact that the peripheral first order vascular bundles are surrounded by two bundle sheaths, a complete mestome sheath and an interrupted Kranz parenchyma sheath, is of considerable interest because this configuration (Figure 5) differs from the condition in the leaf blade as reported in the literature. Many authors record a single bundle sheath in the leaf of *Arundinella* species, which is referred to as the XyMS condition by Hattersley & Watson (1976) or as the MS type by Brown (1977). Examples are Vickery (1935), Brown (1958, 1977), Metcalfe (1960), Jacques-Félix (1962), Crookston & Moss (1973), Hattersley & Watson (1975, 1976), Ellis (1977) and Renvoize (1982a). Other workers have reported double bundle sheaths in the leaf blades of *Arundinella*. Tateoka (1956a) illustrates this PS condition for *A. hirta*, Conert (1957) for *A. decempedalis*, Tateoka (1958) for *A. leptochloa* and *A. villosa* and Li & Phipps (1973) for *A. bengalensis*. Some of these latter workers (Tateoka 1958; Li & Phipps 1973) studied *A. nepalensis* and *A. berteroniana*, which were also examined in the present study, and found them to have only a single bundle sheath. Eight specimens of *A. nepalensis* and one of *A. berteroniana* examined in this study were all observed to have only a single Kranz sheath in the leaf blade. It was, therefore, most unexpected to observe a definite, inner fibrous sheath in the first order bundles of the culm of all three species studied. This may reflect a general condition present in all NADP-me grasses or may be an exceptional condition limited to *Arundinella* and other taxa with distinctive cells. This interesting observation requires further study as it represents a rare exception to the XyMS character for predicting the NADP-me biochemical C_4 type (Hattersley 1987). This anatomical predictor for the NADP-me type may, therefore, apply to leaf blades only or leaves and culms of a given grass may have different photosynthetic pathways.

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Bothalia 19,1: 53–67 (1989)

The vegetation ecology of the Eastern Transvaal Escarpment in the Sabie area. 1. Physical environment

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Keywords: climate, Eastern Transvaal Escarpment, environment, geology, physiography, soil

ABSTRACT

The physiography, geology, soil and climate of a broad transect of the Eastern Transvaal Escarpment in the Sabie area are described. The transect extends from Hazyview (530 m elevation) to Mount Anderson (2 280 m elevation). The description provides a contextual framework for the subsequent vegetation classification.

UITTREKSEL

Die fisiografie, geologie, grond en klimaat van 'n breë lynopname van die Oos-Transvaalse platorand in die Sabie-gebied word beskryf. Die lynopname strek vanaf Hazyview (530 m bo seespieël) tot Mount Anderson (2 280 m bo seespieël). Die beskrywing verskaf 'n koördinerende raamwerk vir die daaropvolgende plantegroeiklassifikasie.

INTRODUCTION

The Eastern Transvaal Escarpment, representing Acocks's (1975) Veld Types 8 (North-Eastern Mountain Sourveld) and 9 (Lowveld Sour Bushveld), is an area subject to land-use conflict. The need to produce food and timber comes into increasing conflict with the need to protect mountain catchments, to conserve natural ecosystems, and to preserve scenic landscapes. Rational land-use planning is required to resolve such conflict (Ferrar *et al.* 1988).

The relevance of plant-ecological studies to land-use planning and management is well known (cf. Pentz 1938, 1945; Bayer 1970; Walker 1976; Edwards 1967; Müller 1983).

In the past, Acocks's (1975) veld types have provided useful information at the scale of broad landscape types. However, to meet the present needs for regional and subregional planning, attention must be focused on sections of these landscapes (Van der Meulen & Scheepers 1978). A more detailed classification of vegetation into ecologically interpretable vegetation units is therefore necessary. A description of the physical environment is fundamental to this task.

STUDY AREA

This study is confined to a broad transect located in the Sabie area of the Eastern Transvaal Escarpment. The transect is situated between the Olifants River in the north and the Crocodile River in the south. Spanning both the Pilgrims Rest and the Nelspruit Districts, it is bounded by latitudes 25°00′ and 25°10′ south and longitudes 30°30′ and 31°10′ east (Figure 1). It is 65 km long and 20 km broad, covering approximately 1 300 km^2. The village of Sabie (1 050 m) is centrally situated in the transect, whilst Hazyview (530 m) and Mount Anderson (2 280 m) are situated at the eastern and western extremities respectively. Its orientation is perpendicular to that of the Escarpment, which has a roughly north-south orientation in this area.

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PHYSIOGRAPHY

Following the rationale of Scheepers (1978) and with certain modifications, the study area may be divided into the following broad physiographic belts (Figure 2):

1, the Subalpine Belt consisting of the rolling plains, level terraces and prominent peaks of the mountain summits (above 1 900 m);

2, the steeply sloping Montane Belt of the mountain slopes to the west of the Escarpment Plateau (± 1 200–1 900 m);

3, the steeply sloping, much dissected Submontane Belt of the escarpment slopes to the east of the Escarpment Crest, and including the Escarpment Plateau (± 900–1 400 m);

4, the gently sloping, undulating Upland Belt of the foothills (± 500–900 m).

A finer subdivision of these physiographic belts leads to the identification of ten physiographic zones (Figure 2). The main criteria for physiographic zonation are geomorphology and altitude.

Since geomorphology does not always vary consistently with altitude, the altitudinal limits of the physiographic zones are arbitrary.

(a) *Summit* (above 1 900 m). It can be divided into Summit Plateau (± 1 900–1 950 m), Summit Slopes (± 1 950–2 100 m), and Summit Peaks (more than 2 100 m).

(b) *Mountain Slopes* (± 1 200–1 900 m). This zone is found between the Escarpment and Summit. Altitudinal subdivision facilitates the recognition of Lower (± 1 200–1 500 m) and Upper (± 1 500–1 900 m)

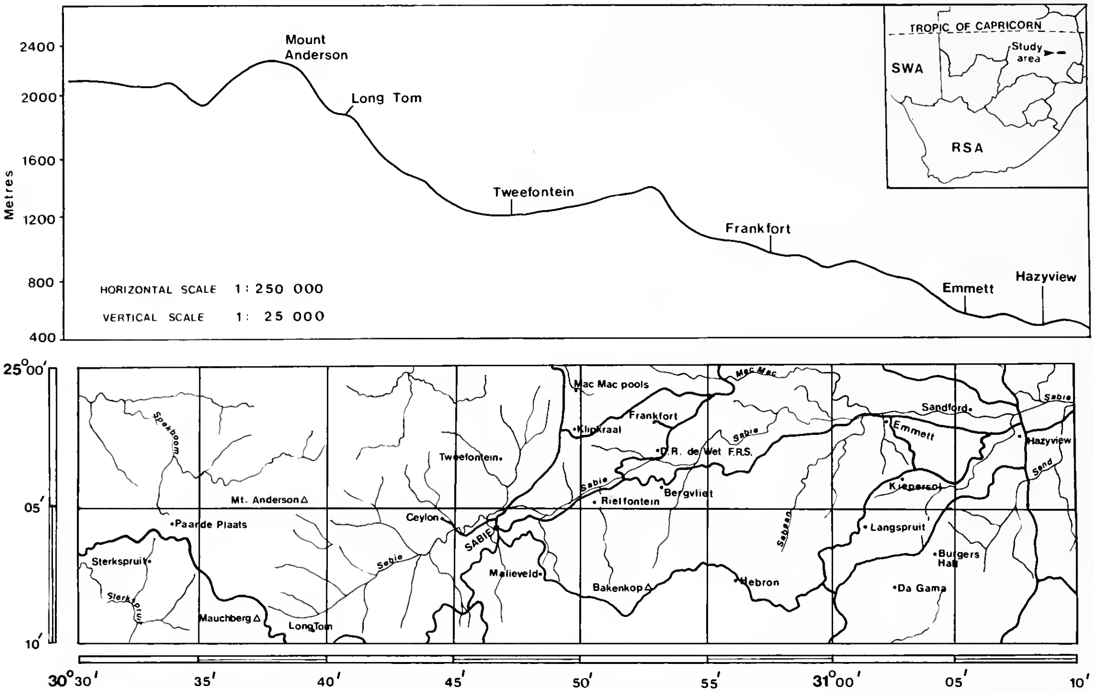

FIGURE 1.—Location of the study area (inset), showing a hypothetical profile (above) and the detailed topography (below). Based on S.A. 1:250 000 Topographical Sheet 2530 Barberton.

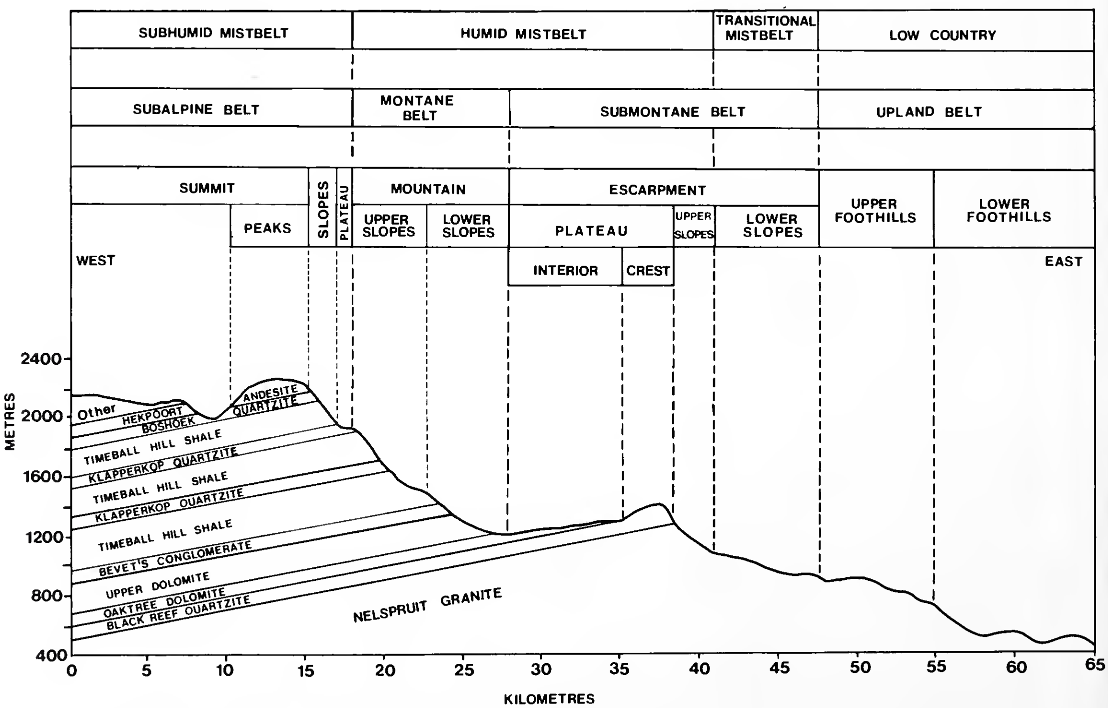

FIGURE 2.—Hypothetical profile of the study area showing physiographic and climatic zonation in relation to geology.

Slopes. Generally, this is a zone of steeply east-sloping hills intersected by valleys and rivulets.

(c) *Escarpment Plateau* (±1 200–1 400 m). This is a flat, gently west-sloping zone forming a shelf or plateau immediately west of, and including, the main Escarpment Crest. The Escarpment Plateau may be divided into the Plateau Interior (± 1 200–1 300 m) and the Plateau Crest (± 1 300–1 400 m).

(d) *Escarpment Upper Slopes* (± 1 100–1 300 m). This is a steeply sloping zone immediately below, and to

the east of the main Escarpment Crest. The slopes are intersected by numerous deeply-incised gorges, kloofs and valleys.

(e) *Escarpment Lower Slopes* (± 900–1 100 m). This zone is due east of the Escarpment Upper Slopes. Valleys are wider and less deeply incised.

(f) *Upper Foothills* (± 700–900 m). This and the following zone represent a transition from the Escarpment Slopes to the Lowveld. The Upper Foothills are characterized by broken undulating terrain.

(g) *Lower Foothills* (± 500–700 m). This zone lies between the Upper Foothills and the Lowveld. Valleys are wide and flat-bottomed, and slopes are gentle.

In Kayser's (1983) morphogenetic classification of south-eastern Africa our Foothills and Escarpment Slopes would be described as comprising 'peneplains, clusters of residual peneplains, regions with mountains and knobs'. His concept of 'peneplains on the lower escarpment level with moderate degree of dissection' finds equivalence in our Lower Foothills, whereas 'peneplains on the upper escarpment level with high degree of dissection' corresponds to our Escarpment Slopes and Upper Foothills. The Escarpment Plateau matches 'marginal zones on the inland plateau level with strong relief' (Kayser 1983). The Plateau Crest Zone is identified as a particularly high benchland scarp, steep and divided into sections (presumably co-incident with the Black Reef Quartzite Formation). The transition from Escarpment Plateau to Mountain Slopes is marked by a medium-height single benchland scarp (presumably co-incident with the Rooihoogte Formation). The Mountain Slopes and Summit would be described as 'high, closed benchland highland' (Kayser 1983).

The main drainage systems eastward are the Sabie and Mac-Mac Rivers (Figure 1). The Sabie River has its source in the Mount Anderson range and flows east-north-east to the Lowveld. The Mac-Mac River drains the dolomite country southwards from Driekop near Graskop until it swings abruptly east at Mac-Mac Falls and then continues its course to the Lowveld.

GEOLOGY

A major geological survey resulted in the publication of a map of the area south of Sabie in 1960 (Visser & Verwoerd 1960). Since then surveys and lithostratigraphic studies have been undertaken on the Transvaal Supergroup (Zietsman 1964; Button 1973a), the Wolkberg Group (Button 1973b), the Malmani Subgroup (Button 1973c), the Timeball Hill Formation (Eriksson 1973) and the Archaean granite basement (Robb 1978; Lageat & Robb 1984). A great deal of confusion surrounding the lithostratigraphy of the area was cleared up by the recent handbook published by the Geological Survey (SACS 1980).

The whole Escarpment region forms the eastern rim of the Bushveld Igneous Complex of the central Transvaal. The stratigraphy and field nomenclature are shown in Table 1. The varying relief of the Escarpment is determined largely by the underlying geological structure. Essentially, four different geological systems are represented. They are traversed by a network of diabase intrusions. Contacts between the systems are roughly parallel and in a north-south direction.

Nelspruit Granite

Nelspruit Granite, an intrusive of Swazian age, is the oldest rock formation (Table 1). It comprises the biotite-bearing gneissose granites and migmatites forming the undulating terrain of the Escarpment Slopes and Foothills (Figure 2).

Overlying the granite, and reaching from the Escarpment Plateau to the Summit, are the stratified rocks of Vaalian age, namely the Transvaal Sequence, represented mainly by the Wolkberg, Chuniespoort and Pretoria Groups (Table 1; Figure 2).

The Wolkberg Group

In the study area, the Wolkberg Group is represented mainly by the Sekororo, Selati Shale and Black Reef Quartzite Formations (Table 1). The Black Reef Quartzite Formation, with its extreme resistance to weathering, is largely responsible for the formation of the Escarpment Plateau with its numerous associated waterfalls, viz. Sabie, Mac-Mac, Lisbon and Berlin Falls. Accelerated weathering along joints results in the characteristic 'pillar and passage' topography with its weird weathering forms ('gendarmes'). The Black Reef Quartzite Formation rarely exceeds 10 m in thickness south of Sabie, but reaches nearly 100 m near Mariepskop in the north. It has a westerly dip of 5°. Shale is always present, particularly near the top, close to the contact with the overlying dolomite (SACS 1980) (Table 1). North-south flowing streams often follow the course of this shale, thus forming a natural division between the Black Reef Quartzite and the dolomites.

The Chuniespoort Group

Overlying the Black Reef Quartzite Formation and rising into the Mountains from the Escarpment Plateau, are the chemical sediments of the Chuniespoort Group, including dolomite, shale, limestone and chert (Table 1; Figure 2). The dolomite is mostly fine-grained and blue-grey in colour with a black weathered surface (owing to manganese oxides) and a wrinkled texture resembling the skin of an elephant, thus deriving the name 'Olifantsklip'.

The incorporation of carbonaceous shale and quartzite with the overlying dolomite produces the dark dolomite of the Oaktree Formation. The Monte Christo, Lyttelton, Eccles and Frisco Formations are characterized on the basis of chert content (Table 1).

Dolomite rock is not often exposed within the high rainfall zone owing to the solubility of the limestone. Exceptions are Spitskop and the cliff line of the Eccles Formation, more resistant to weathering because of the high chert content. The solubility of the limestone has resulted in the formation of caves, usually more visible within the Eccles Formation.

The Pretoria Group

The dolomites mark the transition to the overlying Pretoria Group, which consists predominantly of quartzite and shale in the Rooihoogte, Timeball Hill and

TABLE 1.—Chronostratigraphic and lithostratigraphic divisions in the Sabie area of the Eastern Transvaal Escarpment (adapted from SACS 1980)

Erathem	Sequence	Group	Formation	Member	Lithology	Field nomenclature	Thickness (m)
Mokolian			Transvaal Diabase (intrusive rock)			Transvaal Diabase	
Vaalian	TRANSVAAL	PRETORIA	Hekpoort Andesite		Andesite, quartzite, shale	Hekpoort Andesite	0–200
			Boshoek		Siltstone, shale, quartzite, conglomerate	Boshoek Quartzite	0–90
			Timeball Hill	Klapperkop Klapperkop	Shale Quarzite Shale Quartzite Shale	Timeball Hill Shale/ Klapperkop Quartzite	900–1 600
			Rooihoogte	Bevet's Conglomerate	Quartzite, conglomerate	Bevet's Conglomerate	0–50
		CHUNIESPOORT (MALMANI SUBGROUP)	Frisco		Chert-free dolomite, 1° limestone; carbonaceous shale	Upper Dolomite	300
			Eccles		Chert-rich dolomite		300
			Lyttelton		Chert-free dolomite		120
			Monte Christo		Chert-rich dolomite		200
			Oaktree		Dark dolomite—incorporates carbonaceous shale and quartzite	Oaktree Dolomite	10
		WOLKBERG	Black Reef Quartzite		Quartzite, minor shale, conglomerate	Black Reef Quartzite	0–100
			Selati Shale		Shale Argillaceous quartzite		0–400
			Sekororo		Arkose, shale, quartzite		0–240
			Godwan (Witwatersrand Supergroup: Button 1973a)		Lava, tuff, conglomerate, quartzite, shale		
Swazian			Nelspruit Granite (intrusive rock)			Nelspruit Granite	

Boshoek Formations, and of prominent volcanic elements in the Hekpoort Andesite Formation (SACS 1980) (Table 1; Figure 2). The Rooihoogte Formation consists of a conglomerate/breccia base with quartzite above, forming a clearly visible cliff line from Ceylon State Forest southwards. Waterfalls such as Bridal Veil, Lone Creek and Horseshoe originate on the brow of this cliff line. The conglomerate is distinguished as the Bevet's Conglomerate Member.

The Timeball Hill Formation comprises a shale zone up to 1 600 m thick. Two bands of quartzite, the Klapperkop Quartzite Member, run through the middle of the zone, giving rise to broken cliff faces with waterfalls. The lower band averages 10 m in thickness whereas the upper band reaches up to 60 m. Its resistance to weathering has resulted in the formation of the Summit Plateau (e.g. at Hartebeestvlakte).

The shales and mudstones of the Timeball Hill Formation are carbonaceous, thinly bedded, highly jointed, fissile and dark in colour. They weather to pale colours. In the Sabie area there are anomalous dips due to slumping into solution cavities in the dolomite beneath, and further tilting of the strata sometimes occurs in the vicinity of diabase dykes.

The Boshoek Formation forms a small, prominent cliff above the Timeball Hill Shale. It consists mostly of quartzite, conglomerate, shale and pyroclastics.

In the Hekpoort Andesite Formation flows of basaltic andesite are the most prominent rock types. The Formation reaches a thickness of 200 m.

Transvaal Diabase

Transvaal Diabase, an intrusive of Mokolian age, criss-crosses the entire area in the form of dykes and interbedded sills (Table 1). It is rare in the Wolkberg Group, but most common in the Pretoria Group, particularly in the form of sills. Other basic rocks also make up these sills, those in the upper Chuniespoort Group and Pretoria Group being composed of pyroxenitic material. Sills occur most frequently between the two bands of Klapperkop Quartzite and within the Boshoek Formation. Dykes run mostly in a north-north-easterly direction.

SOILS

Von Christen (1959, 1964) studied 40 soil profiles in the Escarpment area in an attempt to gain insight into nutrient cycling and podzolization processes under pine stands. Subsequently a land type survey was conducted by Schoeman *et al.* (1980), which included the samples of 10 profiles.

The description which follows is based largely on the study of 439 profiles covering the widest possible range in soil and site conditions (Schutz in prep.). Soil properties are strongly influenced by parent material and geological substrate (Table 2).

Nelspruit Granite. The soils derived from the granites are deep, well drained, apedal, red, ferrallitic, and highly leached. Well decomposed granite saprolite is quite frequently encountered within the soil profile below a depth of 800 mm. Quartz grit, often in the form of a broken stoneline, is commonly found in the upper B horizon. Coarse sand is prevalent, mainly towards the surface, whereas the subsoil, or decomposed saprolite is siltier. Although the clay content of the B horizons of these soils is usually high (sandy clay loam to sandy clay), the water-holding capacity of the topsoil is low. In bottom-land positions and river terrace areas, hydromorphic soils tend to develop. These soils can be extremely wet during summer.

Organic carbon content in the topsoil of granitic soils is far lower than that of other soils in the area (2,3 %). This is probably owing to accelerated decomposition of organic substances occasioned by high temperatures (Fränzle 1984). Some pockets of organic rich or humic topsoils (Oakleaf Form) do occur in narrow drainage lines or concave footslopes. Otherwise topsoils are relatively pale in colour (usually Hutton soils).

Selati Shale. Soils derived from Selati shale are not extensive, occurring in a narrow band along the Escarpment Crest, where the Black Reef Quartzite Formation has been eroded. Parent materials are shale and quartzite.

These are the shallowest of all the soils in the area (740 mm) and the bedrock is usually overlain by a layer of hardpan ferricrete. In summer, the water table is generally high. In winter, however, slow but efficient drainage is facilitated both by the sandy texture of the soil and by the slight westerly dip of the strata (Figure 2). These soils can thus be particularly dry in winter. Such fluctuations of the water table together with eluviation are conducive to the formation of bleached E horizons.

Soils derived from Selati shale are usually sandy clay loams with a coarse sandgrade in the A horizon. Stonelines are common when the parent material is shale. On the shallow soils of the Escarpment Crest the dominant soil form is the Glenrosa. Profiles of the Hutton, Oakleaf and Griffin Forms develop on the deeper soils.

Black Reef Quartzite. Soils on the Black Reef Quartzite Formation extend further south than Selati soils, but are also not extensive. South of Sabie all sandy soils along the Escarpment Crest are derived from Black Reef material. North of Sabie they occur in a band parallel with Selati soils, but generally further west down the dipslope.

Soils on Black Reef Quartzite are mostly very shallow over solid bedrock. Under grassland, however, fairly deep soils have developed. Of all soils in the area they have the deepest A horizons (450 mm).

Soils on Black Reef Quartzite are sandy loams, with the highest percentage sand (78 %) of all the soils. They also have the darkest surface soils, with lowest values and chromas. Organic, peaty topsoils are common, reaching a maximum of 9,3 % organic carbon.

The dominant soil form is the Hutton, but Mispah, Clovelly, Inanda and Oakleaf Forms are also common. Less common soil forms include Champagne (under marshy conditions) and Houwhoek and La Motte (under highly leached conditions).

Oaktree. Towards the Plateau Interior, the Oaktree soils begin to appear. They are distinguished from Black Reef sands by an increase in clay content of the subsoil.

TABLE 2.—Summary of mean soil properties of 439 sites covering six geological formations in the Sabie area of the Eastern Transvaal Escarpment (after Schutz in prep.)

Soil property	Nelspruit Granite (n = 139)	Selati Shale (n = 27)	Black Reef Quartzite (n = 20)	Oaktree (n = 35)	Dolomite (n = 111)	Timeball Hill (n = 107)
A hor. depth (mm)	300	240	450	200	200	180
B hor. depth (mm)	1 000	520	660	880	1 020	690
Solum depth (mm)	1 290	740	1 040	1 090	1 220	870
A1 hor. sand (%)	58	57	78	43	33	36
B21 hor. clay (%)	39	29	9	42	45	43
B hor. stone (%)	14	29	10	11	17	47
A1 hor. colour	dark reddish brown	dark brown (black)	dark brown (black)	yellow-brown	dark reddish brown	dark reddish brown
B21 hor. colour	red	yellow	dark yellowish brown	(dark) red	(yellowish) red	red
A1 hor. organic C (%)	2,3	5,3	3,5	5,2	3,5	4,3
A1 hor. pH (water)	4,9	4,5	4,8	4,6	5,0	4,6
A1 hor. exch. acidity (m.e./100 g)	1,2	2,2	1,3	1,4	1,0	2,2
P (mg/kg)	6,7	6,3	6,2	3,4	3,9	6,0
K (mg/kg)	38,0	34,0	18,0	25,0	46,0	32,0
Ca (mg/kg)	117,0	43,0	13,0	16,0	132,0	39,0
Mg (mg/kg)	34,0	12,0	6,0	9,0	37,0	15,0
Al (m.e./100 g)	0,58	1,37	0,66	0,93	0,43	1,58
B21 hor. K + Ca + Mg/100 g clay	1,5	0,7	1,6	0,3	0,9	0,7
Dominant soil forms	Hutton	Glenrosa	Hutton Clovelly	Griffin	Hutton Griffin	Hutton Glenrosa

A horizons are shallow but the solum is moderately deep (about 1 090 mm). The topsoils have the highest percentage of fine sand of all the soils (together with Timeball Hill Formation). They are generally clay loams except in cases where B horizons are overlain with a colluvial, dark sandy A horizon derived from Black Reef Quartzite. B horizons are classified as clay. Some of the wetter B horizons tend to have massive structure. Stone content of the B horizon is low (11 %).

Surface horizons are usually dark when associated with Black Reef Quartzite soils. Yellow-brown apedals over red apedals abound. The B horizon has the highest colour value of all the soils.

Dolomite. Soils derived from dolomite are deep, and well drained. Only on ridge tops and steep slopes does the unweathered rock come close to the surface. The presence of many chert stones and manganese concretions suggests that these soils are transported.

Of all soils in the area, dolomite soils have the highest pH and lowest exchange acidity, probably owing to their limestone origin. Although P levels are low, the sum of basic cations is high, making them the most fertile of soils in the area. Often, there is such colluvial mixing of unconsolidated rock with the red soil matrix that classification of the soil becomes difficult. Otherwise, Hutton and Griffin Forms are usually dominant.

Timeball Hill. Because they are developed in the dissected terrain and steep slopes of the Mountain and Summit Zones, the soils derived from the Timeball Hill Formation tend to be shallow, except on terraces and valley bottoms. The A horizons are shallower than those of other soils in the area. Pockets of silty clay loam 400–500 mm deep are nevertheless prevalent on the slopes, and root penetration is further facilitated by cracks in the shale. Where the shale strata dip (in association with diabase intrusions), weathering is usually deeper than where strata are horizontal.

Soils are well drained clay loams with a fine sand-grade in the topsoil. Subsoils are high in clay content, but can be quite sandy in areas below the two Klapperkop Quartzite cliff lines. The high subsurface stone content (47 %) is typical of these soils. The stones may be loose, or compacted into stonelines, particularly where there is shale colluvium over diabase.

Transvaal Diabase. Soils derived from Transvaal Diabase are not easily recognizable as they are always buried below colluvial topsoil from the adjacent country rock, from which they are separated by a stoneline at 300 to 500 mm depth.

Diabase soils therefore exist only as subsoils and their position as an important subdivision of soils is questionable.

CLIMATE

The Eastern Transvaal Escarpment lies in a seasonally arid, subtropical region, with hot wet summers and cool dry winters. It forms a transition area between the warmer Lowveld to the east and the climatically more extreme Highveld plateau to the west. Summer to winter shifts in the position of the high pressure system of the southern hemisphere play a major role in the constitution of weather (Fabricius 1988).

A climatic gradient facilitates the recognition of two major climatic belts based on altitudinal distribution of mist. These belts are especially meaningful for identifying gross climatic variability. Following Scheepers (1978), there is the Mistbelt of the high, cooler altitudes as opposed to the Low Country of the low, warmer altitudes (Figure 2). The boundary between these two belts is irregular and poorly defined in the study area, but appears to fluctuate between 900 and 1 100 m elevation. This zone of fluctuation may constitute a third climatic belt, namely Transitional Mistbelt. Its range conforms to Scheepers's (1978) arbitrary lower limit of about 1 050 m elevation. A fourth climatic belt, derived from the subdivision of Mistbelt into 'moist' and 'dry' sectors (Humid and Subhumid Mistbelt respectively, Figure 2), may also be justified (Deall 1985). The Subhumid Mistbelt (represented by the Summit Zone), is a distinctly cooler and drier sector of the Mistbelt (Figures 3 & 4). It is frequently misty up to about 1 800 m elevation and completely clear on the Summit above. The boundary between Humid and Subhumid Mistbelt is therefore assumed to co-incide with the transition from Montane to Subalpine Belt (Figure 2).

Fabricius's (1984, 1988) hygric classification of south-eastern Africa, based on a humidity index (the ratio of precipitation to potential evapotranspiration—Papadakis 1966), concurs fairly well with the climatic

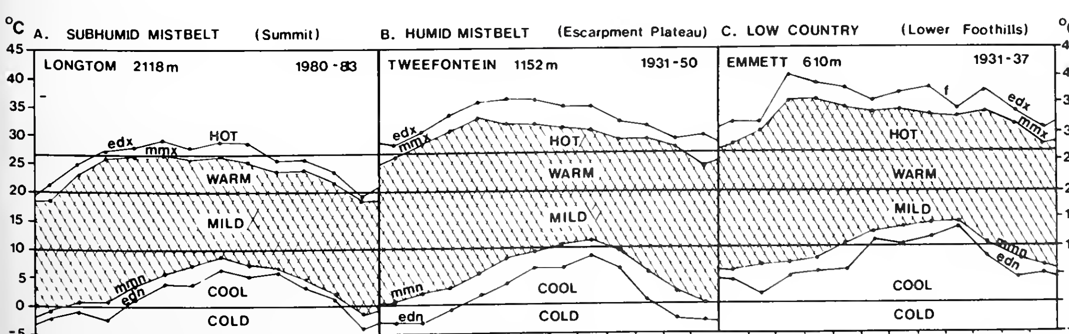

FIGURE 3.—Annual march of extreme daily maximum (edx) and minimum (edn) temperatures and mean monthly maximum (mmx) and minimum (mmn) temperatures for three stations in the Sabie area of the Eastern Transvaal Escarpment. Compiled from Weather Bureau, S. A. (1954a) and from climatological reports of the Soil and Irrigation Research Institute, Private Bag X79, Pretoria 0001.

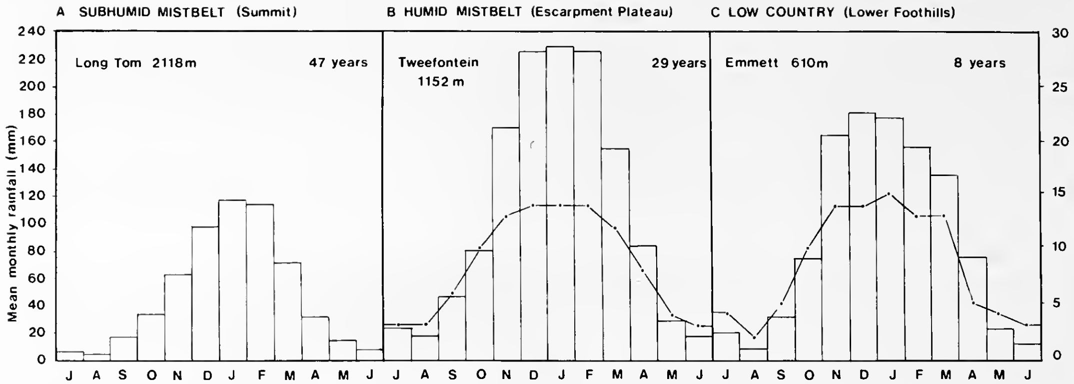

FIGURE 4.—Annual march of mean monthly rainfall (histogram) and mean rainy days per month (graph) for three stations in the Sabie area of the Eastern Transvaal Escarpment. Compiled from Weather Bureau, S.A. (1965b) and from climatological reports of the Soil and Irrigation Research Institute, Private Bag X79, Pretoria 0001.

belt concept outlined above. Low Country and Mistbelt correspond to 'subhumid' and 'humid' types respectively. Transitional and Humid Mistbelts together correspond to 'humid' and 'perhumid' types. The Subhumid Mistbelt peculiar to the Summit is inferred on Fabricius's (1984) map to be 'perhumid'. Insolation, temperature, rainfall, and humidity records (Tables 3, 4, 7 & 8) for Long Tom on the Summit (25°08′ south and 30°37′ east), however, suggest a 'subhumid' rather than a 'perhumid' climatic type. Moreover, the humidity index for Long Tom is calculated as 0,698, a 'subhumid' category in Fabricius' (1984, 1988) classification.

According to Schulze & McGee (1978), light (insolation), temperature, and moisture (precipitation) are the most significant climatic factors in vegetation development. These operate together to produce 'homogeneous environments in which certain plant communities attain importance'.

INSOLATION

Insolation may be measured directly in terms of the quantity of incoming solar radiation, and indirectly by means of sunshine duration. Maps of incoming solar radiation patterns based on solar radiation measurements in southern Africa have been compiled by Schulze & McGee (1978). In addition, the Weather Bureau (1950) has compiled maps showing broad, countrywide patterns of sunshine duration and cloud cover based on a number of stations in South Africa.

Schulze & McGee's (1978) maps show that incoming radiation is subject to seasonal variation. For instance, radiant flux densities for the study area in summer are apparently 80×10^5 Jm^{-2} day^{-1} higher than in winter. The magnitude of seasonal variation is supposedly tempered by the interposing effect of cloud cover which, during summer in the study area, reduces the average duration of bright sunshine by 20–30 % (Weather Bureau 1950).

There is also geographic variation of sunshine duration within the study area. For instance, the average annual duration of bright sunshine in the Mistbelt is less than 60 % of the possible sunshine, whereas it is 60–70 % in the Low Country. Similarly, the Mistbelt experiences less 'bright' days (days with 90–100 % of possible sunshine) than the Low Country (Weather Bureau 1950).

This trend of increasing cloudiness is broken in places on the Summit (Subhumid Mistbelt) however, where, owing to rain-shadow effects, the duration of daily sunshine may be greater than in the Low Country. Thus throughout the year, Long Tom (2 118 m) in the Subhumid Mistbelt experiences more sunshine than Hazyview (530 m) in the Low Country (Table 3).

Besides seasonal and geographic variability, there is also physiographic variability of insolation owing to slope and aspect. Daily incoming radiant flux densities on sloping terrain as a function of slope, aspect, and season have been presented for cloudless days in South

TABLE 3.—Annual march of mean daily sunshine (hours) for two stations in the Sabie area of the Eastern Transvaal Escarpment*

	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Long Tom (2 118 m) 1980–1983	6,6	7,4	7,2	7,5	8,3	8,7	8,4	8,6	8,2	7,4	6,2	7,0
Hazyview (530 m) 1973–1983	6,0	6,5	6,2	6,6	6,6	7,1	7,5	7,2	7,1	6,2	5,9	6,5

* Based on climatological reports of the Soil and Irrigation Research Institute, Private Bag X79, Pretoria 0001.

TABLE 4.—Annual march of temperature extremes, ranges and means (°C) for six stations in the Sabie area of the Eastern Transvaal Escarpment*

Climatic belt	SMB	HMB		TMB	LC	
Station	Long Tom	Tweefontein	Sabie	Bergvliet	Emmett	Hazyview
Altitude (m)	2 118	1 152	1 108	983	610	530
Period	1980–1983	1931–1950	1914–1928	1934–1950	1931–1937	1971–1983
A. Extreme daily maximum						
Jan.	29,0	35,0	34,6	35,1	37,1	42,8
Feb.	28,6	35,0	34,8	35,0	37,8	38,5
Mar.	25,5	32,5	34,1	33,3	34,1	39,5
Apr.	25,5	31,7	32,9	31,7	37,4	38,4
May	23,5	29,4	29,0	30,6	33,4	35,2
Jun.	19,0	30,0	28,1	30,6	30,7	31,5
Jul.	21,2	28,3	28,9	29,4	32,3	34,5
Aug.	25,0	30,6	31,6	32,8	32,2	36,4
Sep.	27,2	33,6	36,0	33,9	40,4	39,8
Oct.	28,1	35,6	37,5	38,3	39,1	41,8
Nov.	29,1	36,1	37,2	37,8	38,2	40,0
Dec.	27,9	36,1	35,6	37,8	35,7	40,6
Year	29,1	36,1	37,5	38,3	40,4	42,8
B. Extreme daily minimum						
Jan.	6,5	6,7	7,9	10,0	10,1	11,8
Feb.	5,2	8,9	10,1	10,6	11,4	12,2
Mar.	5,9	6,7	6,1	9,4	13,3	10,4
Apr.	3,2	1,1	2,4	7,2	8,4	6,8
May	1,2	–2,2	–2,0	3,9	4,6	4,2
Jun.	–4,0	–2,5	–3,1	2,8	5,0	1,7
Jul.	–2,1	–2,8	–4,2	0,0	4,4	1,3
Aug.	–1,0	–2,8	–2,9	1,7	1,8	1,3
Sep.	–2,3	–0,6	–1,5	3,3	5,0	3,2
Oct.	1,3	1,7	4,4	5,0	5,7	8,3
Nov.	4,0	3,9	7,3	7,8	5,6	10,0
Dec.	4,0	6,7	8,8	9,6	11,2	11,6
Year	–4,0	–2,8	–4,2	0,0	1,8	1,3
C. Extreme daily range						
Jan.	22,5	28,3	26,7	25,1	27,0	31,0
Feb.	23,4	26,1	24,7	24,4	26,4	26,3
Mar.	19,6	25,5	28,0	23,9	20,8	29,1
Apr.	22,3	30,6	30,5	24,5	29,0	31,6
May	22,3	31,6	31,0	26,7	28,8	31,0
Jun.	23,0	32,5	31,2	27,8	25,7	29,8
Jul.	23,3	31,1	33,1	29,4	27,9	33,2
Aug.	26,0	33,4	34,5	31,1	30,4	35,1
Sep.	29,5	34,2	37,5	30,6	35,4	30,6
Oct.	26,8	33,9	33,1	33,3	33,4	33,5
Nov.	25,1	32,2	29,9	30,0	32,6	30,0
Dec.	23,9	29,4	26,8	28,2	24,5	29,0
Year	33,1	38,9	41,7	38,3	38,6	41,5
D. Mean daily range						
Jan.	8,7	10,6	10,8	10,2	10,5	11,1
Feb.	9,1	9,9	10,6	9,2	10,7	10,8
Mar.	9,0	10,6	10,6	9,4	10,6	11,2
Apr.	9,1	12,2	13,0	9,7	11,5	13,0
May.	9,4	15,0	15,9	11,0	12,5	14,9
Jun.	10,4	16,0	17,2	12,7	12,8	16,6
Jul.	10,2	15,6	17,3	12,7	13,0	17,1
Aug.	10,4	15,7	16,4	13,0	13,3	16,4
Sep.	11,3	14,6	15,5	12,6	13,4	15,1
Oct.	10,6	13,7	13,6	12,2	13,2	13,1
Nov.	9,4	12,1	11,9	10,8	12,1	11,9
Dec.	9,4	11,3	11,3	10,8	10,9	12,1
Year	9,8	13,1	13,7	11,2	12,0	13,6
E. Mean monthly temperature						
Jan.	16,6	20,1	21,1	21,5	22,8	24,6
Feb.	16,1	19,9	20,6	21,2	22,8	24,2
Mar.	15,3	19,1	19,6	20,4	21,9	23,6
Apr.	13,9	17,2	17,6	19,2	20,1	21,5
May.	11,4	14,8	14,4	17,1	17,9	18,5
Jun.	8,9	12,8	12,2	14,9	16,0	16,1
Jul.	9,0	12,5	12,1	14,4	15,6	16,0
Aug.	10,4	14,2	13,8	16,1	17,2	17,8
Sep.	12,5	16,7	16,7	18,1	18,9	20,0
Oct.	13,9	18,6	18,9	19,7	20,9	21,5
Nov.	15,2	19,1	19,7	20,3	21,5	22,9
Dec.	16,2	19,7	20,7	21,1	22,4	24,2
Year	13,3	17,1	17,3	18,7	19,8	20,9

* Compiled and adapted from Weather Bureau, S.A. (1954a) and from climatological reports of the Soil and Irrigation Research Institute, Private Bag X79, Pretoria 0001.
HMB = Humid Mistbelt; SMB = Subhumid Mistbelt; TMB = Transitional Mistbelt; LC = Low Country.

Africa for the latitudinal range 20°S to 35°S by Schulze (1975). The following general trends for the study area (at 25°S) are derived from these data.

In midsummer, steep slopes receive less radiation than gentle slopes, regardless of aspect. Steep slopes with a south-facing aspect receive greater radiation than those with a north-facing aspect. Incoming radiation on gentle slopes, however, is apparently unaffected by aspect.

At the equinoxes and in midwinter, north-facing aspects receive greater radiation on steep slopes than they do on gentle slopes. The converse applies to south-facing aspects. Finally, regardless of steepness, slopes experience decreasing radiation as they tend more towards south-facing aspects.

TEMPERATURE

Although temperature alone may not be a significant factor in determining major regional vegetation formations, it does play a part in determining floristic variations on a meso- and micro-scale (Schulze & McGee 1978). Such variations result from differential effects of temperature on plant growth rates, seed germination, seedling survival and flowering phenology.

Temperature data for several stations in the study area are given in Tables 4 and 5 and in Figure 3. These data will be discussed comparatively with respect to the different climatic belts.

TABLE 5.—Occurrence of severe frost (less than 0°C in Stevenson screen) at two stations in the Sabie area of the Eastern Transvaal Escarpment*

	Tweefontein (1 152 m)	Bergvliet (982 m)
Earliest date	23 May	–
Latest date	8 September	–
Average first date	23 June	–
Average last date	24 July	–
Average duration	31 days	–
Period of observation	17 years	15 years
Percentage of frost years	59%	0

* Compiled from Weather Bureau, S.A. (1954a).

Subhumid Mistbelt

Long Tom station on the Summit Plateau is considered to be representative of the Subhumid Mistbelt. Mean monthly temperatures range from 8,9°C in June to 16,6°C in January (Table 4E). Average summer and winter temperatures are differentiated by 7,7°C. Extreme daily maxima are greatest in early summer (November: 29,1°C), and extreme daily minima are least in winter (June: −4,0°C) (Table 4A, B; Figure 3A). Both the mean and the extreme daily ranges are greatest in September (11,3°C and 29,5°C respectively) (Table 4C, D). Although data are lacking, frost is assumed to be a significant factor in the climate of the Subhumid Mistbelt.

Humid Mistbelt

Data for the stations Sabie and Tweefontein on the Escarpment Plateau are considered to be representative of the Humid Mistbelt. Mean monthly temperatures in the Humid Mistbelt range from 12,1°C in the coolest month (July) to 21,1°C in the warmest month (January) (Table 4E). Average summer and winter temperatures are differentiated by 9,0°C. Extreme daily maxima are greatest in late spring (October: 37,5°C), and extreme daily minima are least in winter (July: −4,2°C) (Table 4A, B; Figure 3B). Although the mean daily range is least in February (9,9°C) and greatest in July (17,3°C) (Table 4D), the extreme daily range can reach up to 37,5°C in early spring (August to September).

Severe frost (less than 0°C in Stevenson screen) is prevalent in the winter months (June to July), but has been known to occur as early as May and as late as September (Table 5). Its average duration, however, is only 31 days. The prevalence of extremely high day temperatures in the absence of rain in late spring could be inhibitory to many species, especially those on exposed, north-facing (xeric) sites. Likewise, frosty conditions would tend to exclude species which inhabit the lower frost-free climatic belts.

Transitional Mistbelt

Temperature conditions at Bergvliet (Escarpment Lower Slopes) are considered representative of the Transitional Mistbelt. Mean monthly temperatures range from 14,4°C in the coolest month (July) to 21,5°C in the warmest month (January) (Table 4E). Seasonal differentiation of mean monthly temperature is only 7,1°C.

As in the Humid Mistbelt, extreme daily maxima are greatest in late spring (October: 38,3°C), and extreme daily minima are least in winter (July: 0,0°C) (Table 4A, B). Extreme daily maxima, and especially extreme daily minima, are maintained at higher levels than in the Humid Mistbelt. The nett effect is a narrowing of the extreme daily range, its magnitude being greatest in October (33,0°C) and smallest in March (23,9°C) (Table 4C). The greatest mean daily range, however, occurs in August (13,0°C) and the smallest in February (9,2°C) (Table 4D).

Severe frost (less than 0°C in Stevenson screen) has never been recorded in 15 years of observation (Table 5). Isolated pockets of frost may occur, however, in areas of poor air drainage such as valley bottoms.

As in the Humid Mistbelt, the desiccating conditions of late spring are probably inhibiting to many plants. This is enhanced in the Transitional Mistbelt where the dampening effect of mist is less prevalent. Conversely, frost is no longer a factor limiting to plants in the Transitional Mistbelt.

Low Country

Temperature characteristics for this climatic belt are exemplified by the stations Emmett and Hazyview (Lower Foothills). Mean monthly temperatures range from 15,6°C in winter (July) to 24,6°C in summer (January) (Table 4E). As in the Humid Mistbelt, seasonal temperatures differ by 9,0°C. The greatest extreme daily maximum for Emmett (40,4°C) occurred in September, a month earlier than in the Humid and Transitional Mistbelts and two months earlier than in the Subhumid Mistbelt. Conversely, the lowest extreme daily minimum for Emmett (1,8°C) occurred in August, a

month and two months later respectively (Figure 3; Table 4A, B). Thus, the Low Country apparently warms up sooner and cools down later than the Mistbelt as a whole. It therefore has a longer warm-hot season than the latter (Figure 3).

As in the Humid Mistbelt, the greatest extreme daily range occurs in September (36,6°C). The smallest extreme daily range, as in the Transitional Mistbelt, occurs in March (20,8°C) (Table 4C). These extreme ranges co-incide largely with the mean daily range for Emmett, which is greatest in September (13,4°C) and smallest in January (10,5°C) (Table 4D). This suggests that temperatures in the Low Country are seasonally more consistent than in the Humid and Transitional Mistbelts. Frost (less than 0°C in Stevenson screen) is not an important factor in the Low Country although it may occur in isolated pockets, as in the Transitional Mistbelt.

As for the other climatic belts, the Low Country experiences hot dry conditions in late spring prior to the rainy season, and with the absence of mist, conditions become quite arid. Compared to the Mistbelt, the long warm-hot season of the Low Country means an extended growing season for plants, without the inhibiting effect of frost. Furthermore, the greater predictability of temperature regimes in the Low Country probably moderates demands on the adaptive capability of plants.

The Mistbelt as a whole is consistently cooler than the Low Country (Figure 3). Mean monthly temperatures decrease with increasing altitude, Long Tom being approximately 7,5°C and Sabie 3,5°C cooler than Hazyview throughout the year (Table 4E). Likewise, but with the exception of anomalies caused by local geomorphology, the temperature range generally narrows with increasing altitude. For example, the annual average of the mean daily range is 13,6°C at Hazyview (530 m) and only 9,8°C at Long Tom (2 118 m) (Table 4D).

Wind

Although wind data for stations in the area are lacking, wind conditions at nearby stations are considered fairly representative and are therefore presented in Table 6.

TABLE 6.—Seasonal variation in wind direction for three stations in the vicinity of the study area*

Station	Period	Most significant sector from which wind blows during: January	July
Barberton	1939–1948	NE	NE
Pietersburg	1951–1957	E	SSW
Pilgrim's Rest	1939–1948	SE	SW

* Compiled from Weather Bureau, S.A. (1960).

South-easterly to easterly to north-easterly winds predominate during summer (January). These winds blow from the Indian Ocean and are often associated with anticyclonic systems, but can also be associated with cyclonic systems. Their persistence is often the harbinger of the steady rains, drizzle and mist so typical of Escarpment weather in summer.

Winds which blow from the southerly to south-westerly sectors during early summer, especially in the afternoon, are often associated with thunderstorms. During winter, these same winds are associated with cold fronts which are sometimes attended by mist and drizzle.

Violent bergwind conditions, such as the 115 kph westerly wind gust recorded in Pietersburg one September, may occasionally occur (Weather Bureau 1960). These winds become heated by compression as they drop over the Escarpment from the Highveld Plateau and are known to cause considerable physical damage to timber plantations. Indigenous vegetation does not apparently suffer much physical damage, but the low humidity of such winds in the presence of high spring temperatures is sure to have adverse physiological effects. Furthermore, such winds may seriously increase the risk of fire in the dry months of early spring.

Precipitation

Soil moisture is derived from precipitation mainly in the form of rainfall, mist (and fog), dew, hail and snow.

(a) *Rainfall*. The study area falls within the summer rainfall zone where the bulk (85 %) of annual rainfall occurs between November and March. During this period, rain is precipitated mainly in the form of afternoon thunderstorms and instability showers caused by convection in, and convergence of, tropical air masses (Weather Bureau 1965a). The convergence is often occasioned by a particularly pronounced trough of low pressure over Botswana-Namibia (Fabricius 1988). Light orographic rainfall (drizzle) without thunder, and associated with advection, is also prevalent in the summer months, especially on the windward sides of the Mountain and Escarpment Slopes. The small proportion of winter rainfall is derived solely from orographic precipitation, since conditions favouring thunderstorms and instability showers do not persist in the winter months (Weather Bureau 1965a).

On average, the Escarpment region experiences a maximum of over 140 days with measurable rainfall per annum, including 60 to 80 thunderstorms occurring early in the rainy season (Weather Bureau 1965a). Prolonged periods of rain, usually in the form of drizzle are fairly common. For instance, periods with seven consecutive rainy days are encountered on about two occasions per year, and periods with four consecutive rainy days may be encountered on as many as 10 occasions per year (Weather Bureau 1965a).

Rainfall along the eastern Escarpment is generally reliable. In 58 years of recording, 78 % of the annual falls lie within about 20 % of the normal rainfall. A further 10 % of annual falls may be regarded as 'wet' years (120–140 % of normal), and the remaining 12 % as 'dry' years (60–80 % of normal) (Weather Bureau 1965a).

The regional climate is of the monsoon type in which three seasons can be recognized:

1, the rainy season of summer and late summer (i.e. November to March); 2, the cool dry season of 'autumn' to early spring (i.e. April to August); 3, the warm dry

season of spring and early summer (i.e. September to October).

The strongly seasonal nature of the rainfall at three stations in the study area is illustrated in Figure 4. (Caution should be exercised in comparing A and C because of the latter's relatively short period of recording). Maximum rainfall occurs during the warmer months, from November to March. In the Low Country and Humid Mistbelt, November to March are 'superhumid' months in which the monthly rainfall consistently exceeds 100 mm (Walter 1971). In the Subhumid Mistbelt, however, the superhumid period is limited largely to January and February. Also, there is a general increase in rainfall with altitude; the mean monthly January rainfall in the Humid Mistbelt being approximately 52 mm more than in the Low Country. This trend is interrupted on the Summit, however, where rainfall is considerably less than in the Low Country (Figure 4A), and where the humid period is considerably shorter.

The average number of rainy days in both the Mistbelt and Low Country shows much the same type of annual variation as the rainfall amount (Figure 4B, C). Rainfall is nevertheless consistently heavier in the Humid Mistbelt than in the Low Country. For example, for the same number of rainy days in December, Tweefontein in the Humid Mistbelt experiences 45 mm more rainfall than Emmett in the Low Country (Figure 4B, C). The heavier rainfall in the Humid Mistbelt may be attributed to the greater influence of orographic rainfall in this climatic belt.

Rainfall data for specific stations within and around the study area are given in Table 7. Stations are grouped according to the physiographic zones they occupy, and this facilitates the computation of a 'composite' mean or index for each zone (except the Escarpment Upper Slopes). This value broadly represents the mean annual rainfall of each zone. Zonal variability can be explained largely in terms of the prevailing physiography. Thus it is clear from Table 7 that rainfall increases steadily from the Lower Foothills (904 mm) up to a first maximum on the Plateau Crest (1 607 mm). This increase is due to the fact that elevations of land force air currents to rise and cool, and hence to precipitate moisture. Furthermore, even in the absence of general atmospheric movements, mountain regions are known to have local ascending currents that would enhance the precipitation process (Killick 1963). From the Plateau Crest, rainfall decreases into the Plateau Interior (1 200 mm). The effect of the Plateau Crest in creating a local rain-shadow may be responsible for this decrease. From the Plateau Interior, rainfall again increases steadily up to a second maximum on the Upper Mountain Slopes (1 853 mm). Above this zone, rain-shadow effects and falling temperatures probably cause significant reductions in the vapour content of the rising air masses, and rainfall consequently decreases to 774 mm on the Summit (Table 7).

TABLE 7.—Mean annual and absolute maximum and minimum rainfall for 22 stations in the Sabie area of the Eastern Transvaal Escarpment*

Physiographic zone	Station	Altitude (m)	Period (yrs)	Annual rainfall (mm)**			Composite mean (mm)
				mean	max.	min.	
Summit	Long Tom	2 118	47	568	–	–	774
	Elandshoogte	1 980	13	981	–	–	
Upper Mountain Slopes	Long Tom-Bos	1 525	17	1 853	–	–	1 853
Lower Mountain Slopes	Lisbon-Berlyn	1 370	15	1 382	–	–	1 461
	Mac-Mac	1 250	32	1 539	2 332	999	
Escarpment Plateau Interior	Spitskop	1 463	17	1 223	1 819	775	1 200
	Tweefontein	1 152	20	1 241	1 939	806	
	Sabie	1 108	49	1 134	1 967	708	
	Ceylon	1 075†	20	1 200	1 897	799	
Escarpment Plateau Crest	Ophir	1 524	23	1 469	2 317	944	1 607
	Lekkerlach	1 520	21	1 525	–	–	
	Graskop	1 478	44	1 749	–	–	
	Klipkraal	1 372	18	1 683	2 384	1 034	
Escarpment Lower Slopes	Hebron	1 341	16	1 383	1 880	927	1 323
	Bergvliet	983	17	1 263	2 124	852	
Upper Foothills	Swartfontein	1 067	17	1 073	2 157	661	1 183
	Witwater	1 036	21	1 113	2 065	743	
	Wilgeboom	1 000	15	1 306	2 425	1 022	
	Sabie gorge	975	23	1 207	1 901	801	
	Moddersspruit	914	36	1 217	2 292	681	
Lower Foothills	Sandford	579	19	942	1 388	614	904
	Hazyview	530	13	866	–	–	

* Compiled from miscellaneous records of the Weather Bureau, Pretoria; from Weather Bureau, S.A. (1954b): and from climatological reports of the Soil and Irrigation Research Institute, Private Bag X79, Pretoria 0001.
** Rainfall figures adjusted to the nearest millimetre.
† Corrected altitude.

(b) *Mist.** Precipitation from mist (and fog) supplements rainfall precipitation quite significantly. Preliminary results from 'fog-catchers' in the Eastern Transvaal have yielded precipitation figures that exceed those of standard rain gauges by between 105 and 280 % (Fabricius 1969). Where mist or fog is carried through the crown of trees, fine droplets of water collect on foliage and branches. These droplets coalesce and eventually become large enough to drip to the ground, thus contributing directly to soil moisture. This phenomenon, known as 'fog drip', is most significant when mist or fog is moving through tall vegetation. Even when mist or fog is stagnant or when it moves through short vegetation, it contributes indirectly to soil moisture by reducing evapotranspiration. Conversely, stagnant fogs may prevent the precipitation of dew by their inhibiting effect on radiation.

In the Mistbelt, mist is experienced extensively. It also occurs occasionally in the Low Country, on windward, mesic slopes during very wet periods in summer. Cold-air drainage on calm winter nights results in the formation of stagnant valley fogs. In the Low Country, these fogs do not persist beyond early morning, being soon dissipated by the heat of the sun.

(c) *Dew.* Radiation of heat at night causes surface temperatures to fall and, under relatively humid conditions, this results in precipitation of moisture in the form of dew. River valleys are especially subject to dew precipitation.

Dew contributes to soil moisture by reducing the rate and duration of evapotranspiration. Such reduction is accomplished when, with the evaporation of dew, rapid temperature-rises are checked and humidities raised. Dew precipitation may thus serve to ease, or even positively counteract, drought conditions.

(d) *Hail.* Precipitation by hail does not contribute very significantly to soil moisture and neither does it appear to cause much damage to indigenous vegetation. This is mainly because it occurs so infrequently, being prevalent during only four or five spring thunderstorms annually (Weather Bureau 1965a).

(e) *Snow.* Snowfall results from subpolar air masses advancing from the south of the study area (Fabricius 1988). Apart from increasing soil moisture during winter, snow acts as an insulating blanket protecting plants from excessively cold temperatures and preventing the ground beneath from freezing (Killick 1963). Owing to the dryness of the winter, snowfalls in the study area are not particularly frequent. Between 1969 and 1983, only four instances of snow were recorded, usually in early spring (August–September) (Mrs D. Livingstone pers. comm.). The snow is confined to the Summit and Mountain Slopes, where slopes as low as 1 600 m elevation may be affected. Snow in early spring may therefore be particularly beneficial to high-altitude plants whose soil moisture is largely depleted after the prolonged dry conditions of winter.

* In this text, the term 'mist' is used to indicate suspended moisture droplets condensed by the cooling of saturated air masses rising against sloping ground. In contradistinction, the term 'fog' is used to denote such suspended moisture droplets condensed from saturated air cooled at night by radiation and temperature inversion, being restricted mainly to low-lying and level terrain.

Humidity

Data for Hazyview in the Low Country and Long Tom in the Subhumid Mistbelt are presented in Table 8. As expected, humidity levels are correlated with precipitation, temperature, and wind; the highest mean values being recorded in April–May in the Low Country and in February–March in the Subhumid Mistbelt. These periods are associated with decreasing autumn temperatures (Figure 3A, C) near the close of the rainy season, when fairly high levels of soil and atmospheric moisture still prevail (Figure 4A, C). The lowest mean humidity values were recorded in June–July in both the Low Country and the Subhumid Mistbelt. This is a period of low rainfall and low temperatures (Figures 3 & 4). In addition, prevailing winds tend to be dry south-westerly (Table 6).

The period July–August in the Subhumid Mistbelt may be subject to large fluctuations in humidity. For example, the extreme minimum humidity may be as low as 2%, whereas the extreme maximum may be as high as 96% (Table 8). The low minima may arise on occasions when hot, dry south-westerly 'bergwinds' blow. Conditions in the Low Country are not as dry, the lowest extreme minimum humidity being 11% in September.

Table 8 shows the situation at the extremes of the study area only. Humidities for the intermediate Humid and Transitional Mistbelts are obviously expected to be higher than those for either the Subhumid Mistbelt or the Low Country.

CONCLUSION

The foregoing treatment has been necessary for establishing a basic environmental context for vegetation classification (cf. Deall *et al.* 1989). Environmental attributes are largely responsible for determining plant-species distributions. Discussion of the environment, therefore, draws attention to the potential determinants of vegetation composition, vegetation structure, and vegetation distribution. The Eastern Transvaal Escarpment is a region with a great diversity of natural habitats. It is this diversity which elicits the vegetation response reflected in the numerous syntaxa described elsewhere (cf. Deall *et al.* 1989).

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TABLE 8.—Annual march of mean and extreme maximum and minimum humidity for two stations in the Sabie area of the Eastern Transvaal Escarpment*

Humidity parameter (%)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Long Tom Station (1980–1983) in the Subhumid Mistbelt, 2 118 m alt.												
Extreme max.	100,0	100,0	100,0	98,0	97,0	94,0	96,0	96,0	95,0	90,0	81,0	95,0
Extreme min.	16,0	12,0	14,0	13,0	9,0	8,0	2,0	3,0	11,0	9,0	10,0	13,0
Mean max.	85,7	89,8	88,7	81,9	73,7	65,2	66,7	66,5	69,1	69,0	69,5	73,5
Mean min.	47,3	50,1	44,6	38,3	33,9	27,7	26,9	30,1	30,5	31,5	36,9	36,2
Hazyview Station (1978–1983) in the Low Country, 530 m alt.												
Extreme max.	98,0	95,0	96,0	97,0	97,0	98,0	97,0	97,0	95,0	96,0	95,0	97,0
Extreme min.	16.0	20,0	17,0	19,0	17,0	15,0	13,0	12,0	11,0	14,0	16,0	18,0
Mean max.	85,6	85,7	86,5	88,5	88,0	85,1	83,9	82,0	83,7	84,7	85,1	86,1
Mean min.	41,9	39,4	38,4	35,5	33,8	28,7	29,3	30,9	32,9	37,0	40,7	37,7

*Compiled from climatological reports of the Soil and Irrigation Research Institute, Private Bag X79, Pretoria 0001.

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The vegetation ecology of the Eastern Transvaal Escarpment in the Sabie area. 2. Floristic classification

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Keywords: Eastern Transvaal Escarpment, floristic classification, phytosociology, PHYTOTAB

ABSTRACT

The indigenous vegetation of the Eastern Transvaal Escarpment in the Sabie area is classified with the aid of the PHYTOTAB program package. Four ecological-formation classes (efc) based on floristics, physiognomy and climate correspond to four data subsets. Plant communities in each efc are defined by means of 46 differential species-groups distributed amongst forest, thicket, woodland, shrubland and grassland structural types. Environmental correlation is facilitated by means of 21 habitat types.

UITTREKSEL

Die inheemse plantegroei van die Oos-Transvaalse platorand in die Sabiegebied is met behulp van die PHYTOTAB-programpakket geklassifiseer. Vier ekologiese formasieklasse (efc) wat op floristiek, fisionomie en klimaat gebaseer is, kom met vier datasubstelle ooreen. Plantgemeenskappe in elke efc word gedefinieer deur middel van 46 differensiële spesiegroepe wat versprei is tussen woud-, ruigte-, bosveld-, struikveld- en grasveldstrukturele tipes. Omgewingskorrelasie word vergemaklik deur middel van 21 habitattipes.

INTRODUCTION

To facilitate land-use planning and management of the Eastern Transvaal Escarpment on a regional and sub-regional basis, the scale of Acocks's (1975) veld types needs to be enlarged (Van der Meulen & Scheepers 1978). A more detailed classification of Veld Types 8 (North-Eastern Mountain Sourveld) and 9 (Lowveld Sour Bushveld) is therefore required. Floristic classifications express relationships between plant communities and their environment and are thus potentially suitable planning tools. This paper describes a detailed floristic classification of Veld Types 8 and 9 in the Sabie area, within the environmental context established by Deall *et al.* (1989). The classification is purely descriptive and predictive, implying no explanation of causality.

METHODS

The study area comprises a broad transect whose locality and physical environment are described comprehensively by Deall *et al.* (1989). Within the transect 251 quadrats (measuring 10 × 20 m each) were distributed subjectively amongst 50 different physiognomic/land type stratification units based on 1: 250 000 Land Type Series 2530 Barberton. The quadrats were distributed as follows: 46 in forest, 64 in thicket, 76 in woodland, nine in shrubland and 56 in grassland [physiognomy based on Edwards's (1983) formation classes]. In each quadrat, all plant species were listed together with their Domin-Krajina cover-abundance values and growth forms (Deall 1985). The total canopy cover and estimated height range of each stratum of vegetation was also recorded for the purpose of physiognomic-structural classification (Edwards 1983). Environmental parameters recorded for each quadrat include the following:

(i) Climatic Belt, based on altitudinal distribution of mist (cf. Deall *et al.* 1989).

(ii) Physiographic Zone, based on altitude and geomorphology (cf. Deall *et al.* 1989).

(iii) Geomorphology, based on position in local landscape. Eight classes were recognized: knolls, terraces, upper slopes, midslopes, foot slopes, dry kloofs, moist stream banks, marshes.

(iv) Aspect, expressed as 'mesoclinal' (67°–247°) and 'xeroclinal' (248°–66°).

(v) Exposure in terms of the degree of exposure to sun and wind, expressed as sheltered, partly sheltered or exposed.

(vi) Lithology (field nomenclature), based on the stratigraphic classification for South Africa (SACS 1980), as adapted by Deall *et al.* (1989).

(vii) Rock cover based on the degree of limitation on mechanical utilization (cf. Van der Meulen 1979).

By means of selected programs in PHYTOTAB (Westfall *et al.* 1982), a provisional phytosociological classification was made on the basis of the entire data set (251 relevés and 1 043 species, including unidentified specimen numbers). Four data subsets were then identified on the basis of floristic and environmental discontinuity (Deall 1985). Species in each subset were then reclassified within the confines of their subset distribution (Coetzee 1983). Thus, both the number of syntaxa (represented by relevé-groups) and the species defining them (represented by differential species-groups), were increased relative to the provisional classification. For the sake of brevity, poorly-defined syntaxa were removed, leaving only those that are clearly defined by

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TABLE 1.—Forest and Mesic Thicket of the Mistbelt and Low Country: an ecological basis for the recognition of seven habitat types (1.1–1.7) and 12 communities (c.1–c.12), confer Table 2

Group	Habitat type	Substrate / site	Communities
Humid Mistbelt Forests	(1.1)	Timeball Hill Shale & Klapperkop Quartzite	Steep moist kloofs; Summit & Upper Mountain Slopes (c.1)
			Mesoclinal Mountain Slopes (c.2)
	(1.2)	Upper Dolomite	Footslopes & stream banks (c.3)
			Steep mesoclinal cliffs (c.4)
	(1.3)	Black Reef Quartzite	Rocky knolls; Plateau Crest (c.5)
	(1.4)	Nelspruit Granite	Steep mesoclinal slopes & kloofs; Escarpment Upper Slopes (c.6)
Transitional Mistbelt Thickets	(1.5)	Nelspruit Granite	Sheltered mesoclinal slopes; Upper Foothills (c.7)
			Partly sheltered xeroclinal sites; Escarpment Lower Slopes (c.8)
Low Country Thickets	(1.6)	Nelspruit Granite & Transvaal Diabase; Upper Foothills	Xeroclinal slopes (c.9)
			Mesoclinal upper slopes (c.10)
Low Country Forests	(1.7)	Nelspruit Granite; Lower Foothills	Sheltered stream banks (c.11)
			Mesoclinal midslopes & stream banks (c.12)

FIGURE 1.—Protected valleys in Lower Mountain grasslands support the *Hypoestes triflora—Dovyalis lucida* Tall/Short Forest (c.3).

differential species-groups. Both non-differential species and species-groups defining more than a single syntaxon were also removed*. Syntaxa were reduced to single columns by transforming the cover-abundance values of differential species to constancy values thereby creating synoptic tables (Deall 1985).

RESULTS

The four data subsets correspond to four ecological-formation classes (efc) based on floristics, physiognomy and climate (especially mist). Each efc is represented by a synoptic table (Tables 2, 4, 6 & 8). The syntaxa in each efc are informally ranked as communities and are grouped according to habitat type (Tables 1, 3, 5 & 7).

Communities are named according to the recommendations for a standardized South African syntaxonomic nomenclature system proposed by the Botanical Research Institute, Pretoria (Scheepers *et al.* MS). Each name comprises a differential species followed by a dominant species and a physiognomic-structural term (Edwards 1983).

Further information on species mentioned in the text but not included in synoptic tables is documented in an annotated checklist (Deall & Backer 1989).

In instances where plants could not be identified beyond the generic level, the epithet sp. is appended (e.g. *Combretum* sp.). It should be noted that such a name may not necessarily refer to a consistent species concept, but may include various species within the genus.

Differential species are not listed in the community descriptions which follow but are referred to in the synoptic tables instead (Tables 2, 4, 6 & 8).

1 FOREST AND MESIC THICKET OF THE MISTBELT AND LOW COUNTRY

Mesic Thicket (Table 1) refers to a denser, more lush type of thicket which normally occurs in the Mistbelt. Where it occurs in the Low Country, it is usually in mesic situations, i.e. riparian or south-facing. Total vegetation cover is usually more than 75 %. Associated communities are represented throughout the altitudinal range but are notably absent on the Summit Peak and on the Escarpment and Summit Plateaux.

1.1 Humid Mistbelt forest associated with Timeball Hill Shale and Klapperkop Quartzite

c.1 *Buddleja salviifolia—Leucosidea sericea* Tall (riparian) Forest

Confined to steep moist kloofs on Summit and Upper Mountain Slopes, notably at Mount Anderson and Blyfstaanhoogte. Differential and dominant species are indicated in Table 2 (Group A). Non-differential dominants include *Diospyros whyteana*.

c.2 *Ochna arborea* var. *arborea—Combretum kraussii* High Forest

Covering extensive areas (e.g. 'Maritzbos') on mesoclinal Mountain Slopes. Differential and dominant species are indicated in Table 2 (Group B). Non-differential dominants include *Cussonia spicata, Syzygium gerrardii, Oxyanthus speciosus* subsp. *gerrardii*, *Cassipourea gerrardii*, *Sclerochiton harveyanus* and *Olea capensis* subsp. *macrocarpa*.

1.2 Humid Mistbelt forest associated with Dolomite,Lower Mountains

c.3 *Hypoestes triflora—Dovyalis lucida* Tall/Short Forest

Occurring on footslopes and stream banks, Vertroosting Nature Reserve (Figure 1). Differential and dominant species are indicated in Table 2 (Group C). Non-differential dominants include *Xymalos monospora* and *Sclerochiton harveyanus*.

c.4 *Streptocarpus cyaneus—Dovyalis lucida* Short Forest

* Full phytosociological tables are nevertheless available on request from the Vegetation Ecology Division, Botanical Research Institute, Private Bag X101, Pretoria 0001.

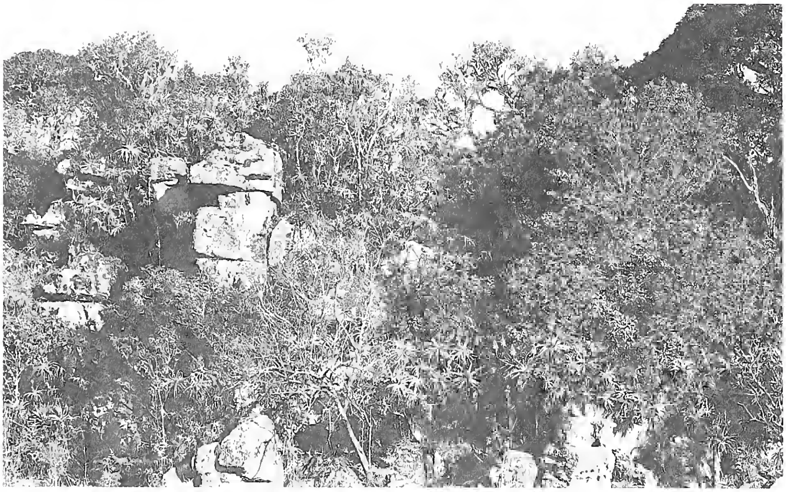

FIGURE 2.—*Ekebergia pterophylla – Psychotria zombamontana* Tall/Short Forest associated with Black Reef Quartzite outcrops, Plateau Crest (c.5). *Aloe arborescens* is noteworthy on massive boulders protruding through the canopy.

Confined to steep mesoclinal cliffs, notably at Sabie. Differential species are indicated in Table 2 (Group D). Dominant species include *Kiggelaria africana, Diospyros whyteana* and *Polystichum luctuosum*.

1.3 Humid Mistbelt forests associated with Black Reef Quartzite outcrops

c.5 *Ekebergia pterophylla–Psychotria zombamontana* Tall/Short Forest

Scattered on rocky knolls of the Plateau Crest, notably in Mac-Mac Nature Reserve (Figure 2). Differential and dominant species are indicated in Table 2 (Group E). Non-differential dominants include *Clivia caulescens* and *Syzygium gerrardii*.

1.4 Humid Mistbelt forests associated with Nelspruit Granite

c.6 *Clerodendrum myricoides–Syzygium gerrardii* Tall Forest

Occurring on steep mesoclinal slopes and kloofs of Escarpment Upper Slopes (Figure 3). Differential species are indicated in Table 2 (Group F). Dominant species include *Combretum kraussii*, *Oxyanthus speciosus* subsp. *gerrardii*, *Psychotria capensis* and *Tricalysia capensis*.

1.5 Transitional Misbelt thickets associated with Nelspruit Granite

c.7 *Clematis brachiata–Acacia ataxacantha* Short Thicket

Covering sheltered mesoclinal slopes of Upper Foothills, especially Bergvliet Forest Reserve. Differential species are indicated in Table 2 (Group G). Dominant species include *Brachylaena discolor* subsp. *transvaalensis*, *Protorhus longifolia*, *Maytenus mossambicensis* subsp. *mossambicensis*, *Canthium gueinzii* and *Rhoicissus tomentosa*.

c.8 *Tetradenia* 'complex'–*Acacia ataxacantha* Short Thicket

Occurring patchily on partly sheltered xeroclinal sites of the Escarpment Lower Slopes (Figure 4). Differential species are indicated in Table 2 (Group H). Dominant species include *Canthium inerme* and *Smilax kraussiana*.

FIGURE 3.—*Clerodendrum myricoides–Syzygium gerrardii* Tall Forest (c.6) showing *Tricalysia capensis* dominating the understorey.

FIGURE 4.—Woodland variant of the *Tetradenia* 'complex'—*Acacia ataxacantha* Short Thicket on partly sheltered sites of the Escarpment Lower Slopes (c.8).

1.6 Low Country thickets associated with Nelspruit Granite and Transvaal Diabase, Upper Foothills

c.9 *Pittosporum viridiflorum—Acacia ataxacantha* Short Thicket

Scattered on diverse xeroclinal slopes. Differential species are indicated in Table 2 (Group I). Dominant species include *Syzygium cordatum*, *Parinari curatellifolia* and *Diospyros whyteana*.

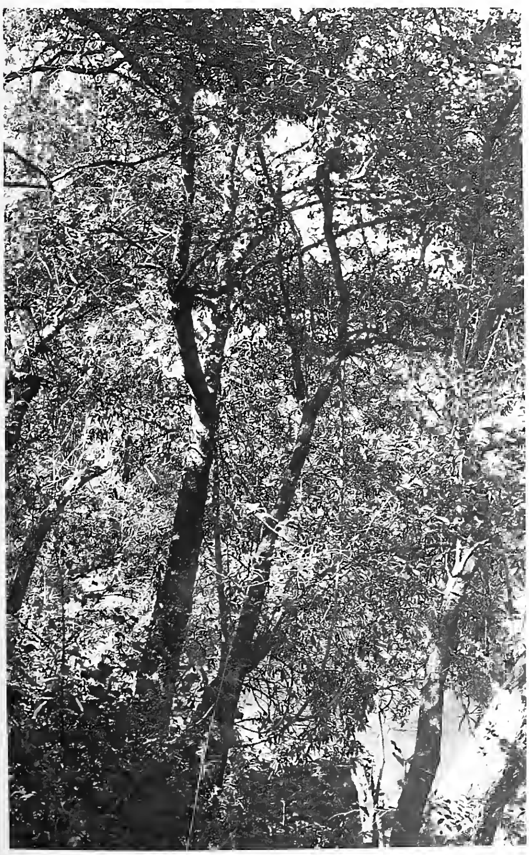

FIGURE 5.—*Pavetta* sp.—*Celtis africana* Tall Forest on sheltered banks of the Sabie river, Lower Foothills (c.12).

c.10 *Pycnostachys urticifolia—Acacia ataxacantha* Short Thicket

Occurring intermittently on mesoclinal upper slopes. Differential species are indicated in Table 2 (Group J). Dominant species include *Catha edulis*, *Diospyros whyteana*, *Diospyros lycioides* subsp. *sericea*, *Smilax kraussiana* and *Euclea* 'complex'.

1.7 Low Country forests associated with Nelspruit Granite, Lower Foothills

c.11 *Schoenoplectus corymbosus—Syzygium cordatum* Tall (riparian) Forest

Confined to sheltered stream banks. Differential species are indicated in Table 2 (Group K). Dominant species include *Anthocleista grandiflora*, *Syzygium cordatum*, *Diospyros whyteana*, *Oplismenus hirtellus* and *Dalbergia armata*.

c.12 *Pavetta* sp.—*Celtis africana* Tall Forest

Situated on mesoclinal midslopes and stream banks (Figure 5). Differential species are indicated in Table 2 (Group L). Dominant species include *Monanthotaxis caffra*, *Dalbergia armata*, *Rhoicissus tomentosa*, *Maytenus undata*, *Oplismenus hirtellus* and *Dietes iridioides*.

2 WOODLAND AND XERIC THICKET OF THE LOW COUNTRY

Xeric Thicket (Table 3) refers to the 'scrubby' type of thicket normally associated with the Low Country. Associated communities are represented mainly on xeroclinal upper slopes and midslopes underlain by Nelspruit Granite or Transvaal Diabase.

2.1 Partly sheltered woodlands and thickets of rocky sites, Lower Foothills

c.13 *Monanthotaxis caffra—Rhus pentheri* Short Thicket

TABLE 2.—Floristic classification of Forest and Mesic Thicket of the Mistbelt and Low Country

Habitat type	1.1		1.2		1.3	1.4	1.5		1.6		1.7	
Community number	1	2	3	4	5	6	7	8	9	10	11	12
Total relevés per Community	2	10	2	3	4	4	6	6	5	4	2	5
A. Differential species of Community 1												
* *Buddleja salviifolia* (SH)	5											
Streptocarpus pentherianus (FB)	5	1										
* *Leucosidea sericea* (TR)	5			2								
Rhamnus prinoides (TR)	5			2			1					
Myrsiphyllum ramosissimum (FB)	5	1										
* *Olinia emarginata* (TR)	5	1										
B. Differential species of Community 2												
* *Ochna arborea* var. *arborea* (TR)		4			2							
Scutia myrtina (TR)		3										
Protasparagus setaceus (FB)		5		2								
Bersama tysoniana (TR)		1										
Asplenium sandersonii (PT)		1										
Jasminum angulare (SH)		2										
Podocarpus falcatus (TR)		2										
C. Differential species of Community 3												
* *Hypoestes triflora* (FB)	3		5									
Dumasia villosa var. *villosa* (LN)		1	5									
Adiantum capillus-veneris (PT)			5									1
Clerodendrum glabrum var. *glabrum* (TR)		1	5							2		
D. Differential species of Community 4												
Streptocarpus cyaneus (FB)				5								
Psydrax livida (TR)				5								
Cyphostemma anatomicum (LN)				4								
Buddleja auriculata (SH)	3			4								
E. Differential species of Community 5												
Ekebergia pterophylla (TR)					5							1
Hypolepis sparsisora (PT)					4							
* *Aloe arborescens* (SH)					4							
Lycopodium gnidioides (PT)					4							
Plectranthus rubropunctatus (SH)					4							
Polystachya ottoniana (EP)					4							
Rhus tumulicola (SH)					3							
Bulbophyllum sandersonii (EP)					3							
Rothmannia capensis (TR)		1			3							
Cyanotis pachyrrhiza (FB)					3							
Rumohra adiantiformis (PT)					3							
F. Differential species of Community 6												
Clerodendrum myricoides (TR)						3						1
G. Differential species of Community 7												
Clematis brachiata (LN)	3			2			3					
Myrica pilulifera (TR)					2		2					
Secamone parvifolia (LN)							2					
Choristylis rhamnoides (TR)		1					2			2		
H. Differential species of Community 8												
Tetradenia 'complex' (SH)								4			3	
Aloe longibracteata (FB)								4				
Cryptolepis oblongifolia (FB)								2				
Loudetia simplex (GR)								2				
Gerbera jamesonii (FB)								2	1			
Indigofera swaziensis (SH)								3				1
Pearsonia sessilifolia 'complex' (FB)								3				
Rhus transvaalensis (TR)								3				1
I. Differential species of Community 9												
Pittosporum viridiflorum (TR)		1							5			
Annona senegalensis (TR)									2			
Cassia petersiana (SH)									2	2		
J. Differential species of Community 10												
Pycnostachys urticifolia (SH)							1			4		
Jacaranda mimosifolia (TR)										3		
Triumfetta pilosa var. *effusa* (FB)										3		
Dalechampia capensis (LN)									1	3		
K. Differential species of Community 11												
Schoenoplectus corymbosus (CY)											5	
Lantana camara (SH)										2	5	
Thelypteris gueinziana (PT)											5	
L. Differential species of Community 12												
Pavetta sp. (SH)									1			4
Kirkia acuminata (TR)												2
Berchemia zeyheri (TR)												2
Aneilema aequinoctiale (FB)									1			2
Chionanthus foveolata subsp. *foveolata* (TR)		1										2
Ceropegia woodii (LN)												2
Rhus pentheri (TR)												2

* Dominant species. Digits 1–5 in matrix denote constancy values. For explanation of 'complex' see Deall & Backer (1989). Growth forms: TR = Tree; SH = Shrub; LN = Lianoid; EP = Epiphyte; FB = Forb or herb; CY = Sedge; GR = Grass; PT = Fern.

TABLE 3.—Woodland and Xeric Thicket of the Low Country: an ecological basis for the recognition of four habitat types (2.1–2.4) and 11 communities (c.13–c.23), confer Table 4

- Partly sheltered Woodlands & Thickets; rocky sites
  - (2.1) Lower Foothills
    - >80% vegetation cover (c.13)
    - <80% vegetation cover (c.14)
  - (2.2) Upper Foothills >75% vegetation cover (c.15) (c.16) (c.17)
- Exposed Woodlands & Shrublands
  - (2.3) >50% vegetation cover; low rock cover (disturbed)
    - Upper Foothills
      - Low Thicket (c.18)
      - Low Sparse Woodland (c.21)
    - Upper Foothills old lands (c.19)
    - Escarpment Lower Slopes (c.20)
  - (2.4) <50% vegetation cover; very high rock cover (granite sheet rock); Foothills & Escarpment Lower Slopes
    - Woodland (c.22)
    - Shrubland (c.23)

Notable around Sandford, with a vegetation cover of more than 80 %. Differential species are indicated in Table 4 (Group A). Dominant species include *Zanthoxylum davyi*, *Acacia ataxacantha*, *Catha edulis* and *Maytenus undata*.

c.14 *Combretum collinum* subsp. *gazense–Panicum maximum* Short Closed Woodland

Widespread, with a vegetation cover of less than 80 %. Differential species are indicated in Table 4 (Group B). Dominant species include *Combretum collinum* subsp. *suluense*, *Heteropyxis natalensis*, *Panicum* 'complex' and *Aloe barbertoniae*.

2.2 Partly sheltered woodlands and thickets of rocky sites, Upper Foothills

c.15 *Hyparrhenia gazensis–Bauhinia galpinii* Short Thicket

Situated around Evert and Emmett with a vegetation cover of more than 75 %. Differential species are indicated in Table 4 (Group C). Dominant species include *Dombeya rotundifolia* subsp. *rotundifolia*, *Acacia ataxacantha*, *Maytenus heterophylla* and *Protasparagus* sp.

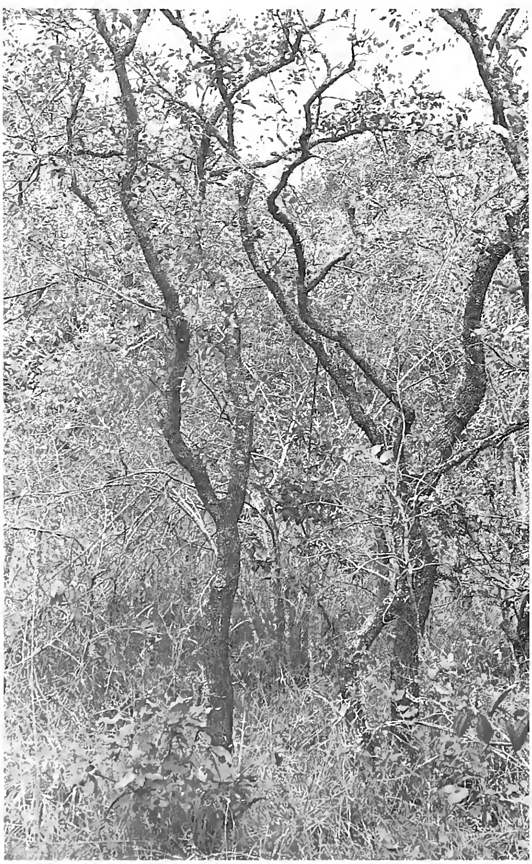

FIGURE 6.—*Dicoma zeyheri–Parinari curatellifolia* Short Closed Woodland on xeroclinal granite slope, Upper Foothills (c.16). *Loudetia simplex* dominates the field layer.

c.16 *Dicoma zeyheri–Parinari curatellifolia* Short Thicket/Closed Woodland

Notable at Zeederberg with a vegetation cover of more than 75 % (Figure 6). Differential species are indicated in Table 4 (Group D). Dominant species include *Pterocarpus angolensis*, *Catha edulis*, *Faurea speciosa*, *Diospyros whyteana*, *Bauhinia galpinii*, *Smilax kraussiana* and *Flemingia grahamiana*.

c.17 *Rhynchosia sordida–Parinari curatellifolia* Short Closed Woodland

Widespread, with a vegetation cover of more than 75 %. Differential species are indicated in Table 4 (Group E). Dominant species include *Faurea saligna*, *Themeda triandra*, *Flemingia grahamiana* and *Cymbopogon* 'complex'.

2.3 Exposed woodlands and shrublands with more than 50 % vegetation cover (disturbed) and low rock cover

c.18 *Mucuna coriacea* subsp. *irritans–Antidesma venosum* Low Thicket/Short Closed Woodland

Occurring on heavily utilized sites, Upper Foothills. Differential species are indicated in Table 4 (Group F). Dominant species include *Parinari curatellifolia*, *Bauhinia galpinii*, *Flemingia grahamiana* and *Hyperthelia dissoluta*.

c.19 *Diheteropogon amplectens–Parinari curatellifolia* Low Open Woodland

Associated with old-land disturbance, mainly on Upper Foothills. Differential species are indicated in Table 4 (Group G). Dominant species include *Trema orientalis*, *Smilax kraussiana*, *Flemingia grahamiana* and *Schizachyrium sanguineum*.

c.20 *Andropogon schirensis–Parinari curatellifolia* Short Open Woodland

Situated on disturbed sites of Escarpment Lower Slopes, notably Bergvliet Forest Reserve. Differential species are indicated in Table 4 (Group H). Dominant species include *Loudetia simplex* and *Schizachyrium sanguineum*.

c.21 *Vernonia centaureoides–Hyperthelia dissoluta* Low Sparse Woodland/Tall Sparse Shrubland

Occurring on Upper Foothills in disturbed areas. Differential species are indicated in Table 4 (Group I). Dominant species include *Parinari curatellifolia*.

2.4 Exposed woodlands and shrublands with less than 50 % vegetation cover and high rock cover (usually granite sheet rock)

c.22 *Ceratotheca triloba–Bequaertiodendron magalismontanum* Low Open Woodland

Occurring mainly on Upper Foothills and Escarpment Lower Slopes. Differential species are indicated in Table 4 (Group J). Dominant species include *Combretum molle* and *Loudetia simplex*.

TABLE 4.—Floristic classification of Woodland and Xeric Thicket of the Low Country

Habitat type	2.1		2.2			2.3				2.4	
Community number	13	14	15	16	17	18	19	20	21	22	23
Total relevés per community	6	12	5	2	2	3	3	2	2	5	6
A. Differential species of Community 13											
Monanthotaxis caffra (SH)	5										
Mimusops zeyheri (TR)	4	1									
Ansellia gigantea (EP)	3		2								
Eulophia streptopetala (FB)	4	1									
Scadoxus multiflorus subsp. *multiflorus* (FB)	3										
Plectranthus sp. (SH)	2		1								
B. Differential species of Community 14											
Combretum collinum subsp. *gazense* (TR)		3									
Terminalia sericea (TR)		3									
Senecio venosus (FB)		3									
Vernonia natalensis (FB)		3				2					
Lannea discolor (TR)	1	3									1
Chaetacanthus burchellii (FB)		2	1								
Diospyros mespiliformis (TR)		2									
Strychnos madagascariensis (TR)	1	2	1								
Phyllanthus reticulatus (SH)		2									
Maytenus mossambicensis subsp. *mossambicensis* (TR)		2									
C. Differential species of Community 15											
Hyparrhenia gazensis (GR)			4								
Neonotonia wightii (LN)			4								
Triumfetta pilosa var. *pilosa* (FB)			3			2			3		
Euclea natalensis (TR)	1		2								
Ocimum urticifolium (SH)			2								
Erianthemum dregei (EP)			2								
Sphenostylis marginata subsp. *marginata* (LN)			2	3							
D. Differential species of Community 16											
Dicoma zeyheri (FB)				5			2				
Thunbergia atriplicifolia (LN)				5							
Aster sp. (FB)				5	3						
Passiflora edulis (LN)				5		2					
Tridactyle tricuspis (EP)				5						1	
Trimeria grandifolia (TR)				5							
Ipomoea crassipes (FB)				5							
E. Differential species of Community 17											
Rhynchosia sordida (FB)					5						
Senecio serratuloides var. *serratuloides* (FB)					5						
F. Differential species of Community 18											
Mucuna coriacea subsp. *irritans* (LN)		1				5		3			
Triumfetta pilosa var. *tomentosa* (FB)					3	4					
G. Differential species of Community 19											
Diheteropogon amplectens (GR)							4				
Acanthospermum australe (FB)							4		5		
Cassia quarrei (FB)							4				
Hemizygia transvaalensis (FB)							4				
Conyza sumatrensis (FB)				3			4				
H. Differential species of Community 20											
Andropogon schirensis (GR)								5		1	
Gladiolus exiguus (FB)								5			
Diospyros galpinii (FB)								5			
Eriosema gunniae (FB)								5			
I. Differential species of Community 21											
Vernonia centaureoides (FB)									5		
Indigofera oxalidea (FB)									5		
J. Differential species of Community 22											
Ceratotheca triloba (FB)										5	1
Crassula natalensis (FB)										3	
Pellaea calomelanos (PT)		1								3	
Helichrysum kraussii (FB)									3	4	
Protorhus longifolia (TR)										3	
Brachiaria serrata var. *serrata* (GR)										2	
Cephalanthus natalensis (LN)										2	
K. Differential species of Community 23											
**Aloe petricola* (FB)											5
**Myrothamnus flabellifolia* (FB)											4
**Coleochloa setifera* (CY)											4

* Dominant species. Digits 1–5 in matrix denote constancy values. Growth forms: TR = Tree; SH = Shrub; LN = Lianoid; EP = Epiphyte; FB = Forb or herb; CY = Sedge; GR = Grass; PT = Fern.

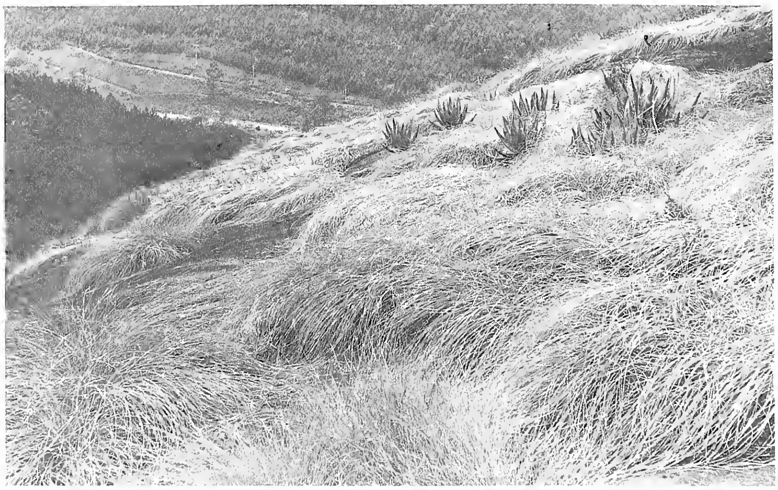

FIGURE 7.—*Aloe petricola—Coleochloa setifera* Short Sparse Shrubland on granite 'dwala' (c.23).

c.23 *Aloe petricola—Coleochloa setifera* Short Sparse Shrubland

Widespread on Foothills and Escarpment Lower Slopes (Figure 7). Differential and dominant species are indicated in Table 4 (Group K). Non-differential dominants include *Cheilanthes viridis* var. *viridis*.

3 WOODLAND AND SHRUBLAND OF THE MISTBELT

Associated communities are evenly distributed between Humid and Subhumid Mistbelts (Table 5).

3.1 Humid Mistbelt communities on partly sheltered midslopes with low rock cover

c.24 *Galopina aspera—Faurea speciosa* Low Open Woodland/Low Thicket

Notable in Spitskop Forest Reserve on xeroclinal sites underlain by Black Reef Quartzite, Escarpment Upper Slopes (Figure 8). Differential species are indicated in Table 6 (Group A). Dominant species include *Faurea speciosa*, *Rhynchosia komatiensis*, *Acalypha wilmsii*, *Eulalia villosa*, *Smilax kraussiana* and *Flemingia grahamiana*.

c.25 *Artemisia afra—Bowkeria cymosa* Low Thicket/ Low Open Woodland

Occurring in Vertroosting Nature Reserve on mesoclinal sites underlain by dolomite, Lower Mountain Slopes. Differential species are indicated in Table 6 (Group B). Dominant species include *Cussonia spicata*, *Bowkeria cymosa*, *Rhus transvaalensis*, *Indigofera swaziensis*, *Rhoicissus tridentata* and *Pteridium aquilinum*.

3.2 Humid Mistbelt communities on exposed Black Reef Quartzite outcrops, Plateau Crest and Escarpment Upper Slopes

c.26 *Tecomaria capensis* subsp. *capensis—Bequaertiodendron magalismontanum* Low Closed Woodland

Situated on xeroclinal upper slopes at Sabie. Differential and dominant species are indicated in Table 6 (Group C). Non-differential dominants include *Psychotria capensis*, *Helichrysum kraussii* and *Cyperus leptocladus*.

FIGURE 8.—*Galopina aspera—Faurea speciosa* Low Open Woodland of Escarpment Upper Slopes (c.24). The community is evidently maintained by fire.

TABLE 5.—Woodland and Shrubland of the Mistbelt: an ecological basis for the recognition of five habitat types (3.1–3.5) and 11 communities (c.24–c.34), confer Table 6

- Humid Mistbelt
  - (3.1) Partly sheltered midslopes; low rock cover
    - Black Reef Quartzite; xeroclinal sites; Escarpment Upper Slopes (c.24)
    - Upper Dolomite; mesoclinal sites; Lower Mountain Slopes (c.25)
  - (3.2) Exposed Black Reef Quartzite; high rock cover; Plateau Crest & Escarpment Upper Slopes
    - Xeroclinal upper slopes (c.26) (c.27) (c.29)
    - Xeroclinal terraces & slopes (c.28)
- Subhumid Mistbelt
  - (3.3) Exposed rocky upper slopes; <75% vegetation cover
    - Klapperkop Quartzite outcrops; mesoclinal Summit Slopes (c.30)
    - Hekpoort Andesite outcrops; xeroclinal Summit Peaks (c.31)
  - (3.4) Marshes & stream banks; Summit Plateau; low rock cover; >75% vegetation cover
    - Exposed marshes; deep hydromorphic alluvium; Timeball Hill Shale (c.32)
    - Partly sheltered mesoclinal stream banks; shallow soil; Timeball Hill Shale or Klapperkop Quartzite (c.33)
  - (3.5) Steep rocky kloofs; Timeball Hill Shale; Summit Slopes
    - Sheltered xero-clinal sites (c.34)

TABLE 6.—Floristic classification of Woodland and Shrubland of the Mistbelt

Habitat type	3.1		3.2				3.3		3.4		3.5
Community number	24	25	26	27	28	29	30	31	32	33	34
Total relevés per community	2	2	3	3	4	4	5	3	4	3	2
A. Differential species of Community 24											
Galopina aspera (FB)	5										
Inula glomerata (FB)	5										
Hyperthelia dissoluta (GR)	5										
Combretum molle (TR)	5		2								
Boophane disticha (FB)	5				2						
Vernonia neocorymbosa (FB)	5										
Eriospermum sp. (FB)	5										
Senecio venosus (FB)	5										
B. Differential species of Community 25											
Artemisia afra (FB)		5									
Lippia javanica (SH)		5				2					
C. Differential species of Community 26											
* *Tecomaria capensis* subsp. *capensis* (TR)			5								
Ochna holstii (TR)			5	2							
* *Ficus ingens* var. *ingens* (TR)			5		2						
Setaria megaphylla (GR)			5								
Tetradenia 'complex' (SH)			4		2						
Arthropteris monocarpa (PT)			4								
Solanum mauritianum (TR)			4								
Canthium mundianum (TR)			4								
Bidens pilosa (FB)			4								
Plectranthus fruticosus (SH)			4								
Heteropyxis natalensis (TR)			4								
Maytenus undata (TR)			4								
Eulophia streptopetala (FB)			4								
D. Differential species of Community 27											
Diospyros galpinii (FB)	3			5							
Gladiolus densiflorus (FB)				5							
Selago hyssopifolia (FB)				4							
Lannea edulis (FB)				4							
Tristachya leucothrix (GR)				4			1				
Pearsonia sp. (FB)				4							
* *Parinari capensis* subsp. *capensis* (FB)				4	2						
E. Differential species of Community 28											
Selago atherstonei (FB)					5	2	1				
* *Aloe petricola* (FB)				2	5						
Burchellia bubalina (TR)					3						
Gladiolus exiguus (FB)					4	2					
F. Differential species of Community 29											
Clutia monticola (FB)	3					4					
Helichrysum 'complex' (FB)				2		3					
Erica drakensbergensis (SH)						3		2			
Pearsonia aristata (FB)						3					
Plectranthus rubropunctatus (SH)						3				2	
Senecio coronatus (FB)						3	1				
Greyia radlkoferi (TR)		3				3					
Conostomium natalense var. *glabrum* (FB)						3					
Pachystigma macrocalyx (SH)						3					
Cephalaria pungens (FB)						3					
Eriosema ellipticifolium (FB)						3	1				
Inulanthera calva (FB)						3					

* Dominant species. Digits 1–5 in matrix denote constancy values. For explanation of 'complex' see Deall & Backer (1989). Growth forms: TR = Tree; SH = Shrub; LN = Lianoid; EP = Epiphyte; FB = Forb or herb; CY = Sedge; GR = Grass; PT = Fern.

TABLE 6.—Floristic classification of Woodland and Shrubland of the Mistbelt (continued)

Habitat type	3.1		3.2				3.3		3.4		3.5
Community number	24	25	26	27	28	29	30	31	32	33	34
Total relevés per community	2	2	3	3	4	4	5	3	4	3	2
G. Differential species of Community 30											
* *Trachypogon spicatus* (GR)					2		3	2			
Crassula sarcocaulis subsp. *sarcocaulis* (FB)						2	2				
Panicum ecklonii (GR)							2				
Tetraselago wilmsii (FB)							2	4			
Ledebouria cooperi (FB)							2				
Gerbera ambigua (FB)							2				
Alloteropsis semialata (GR)							2				
Oxalis obliquifolia (FB)							2	2			
Pentanisia prunelloides (FB)						2	2				
Koeleria capensis (GR)							2				
Euryops pedunculatus (FB)					2		2				
Alepidea longifolia subsp. *longifolia* (FB)							2				
* *Protea roupelliae* subsp. *roupelliae* (TR)							2				
Hypoxis filiformis (FB)							2				
H. Differential species of Community 31											
* *Festuca costata* var. *costata* (GR)								5			
Erica atherstonei (SH)								4			
Cheilanthes pentagona (PT)								4			
* *Protea parvula* (SH)								4			
Cycnium racemosum (FB)							1	5			
I. Differential species of Community 32											
* *Gunnera perpensa* (FB)									4	4	
Nerine angustifolia (FB)									3		
Acalypha caperonioides (FB)		5							4		
J. Differential species of Community 33											
* *Cyathea dregei* (TR)										5	
Agapanthus inapertus subsp. *parviflorus* (FB)							1			4	
Leucosidea sericea (TR)										4	
Clutia affinis (SH)										4	
Pennisetum macrorum (GR)										4	
Diclis reptans (FB)										4	
Helichrysum splendidum (FB)								2		5	
Phygelius aequalis (SH)										4	
K. Differential species of Community 34											
* *Aloe arborescens* (SH)		3									5
Cyperus pseudoleptocladus (CY)							1			2	5
* *Rhus pyroides* (TR)											5
* *Clivia caulescens* (FB)											5
Anthospermum herbaceum (FB)							1				5

* Dominant species. Digits 1–5 in matrix denote constancy values. For explanation of 'complex' see Deall & Backer (1989). Growth forms: TR = Tree; SH = Shrub; LN = Lianoid; EP = Epiphyte; FB = Forb or herb; CY = Sedge; GR = Grass; PT = Fern.

c.27 *Diospyros galpinii–Bequaertiodendron magalismontanum* Tall Open Shrubland/Low Open Woodland

Notable at Sabie on xeroclinal upper slopes. Differential and dominant species are indicated in Table 6 (Group D). Non-differential dominants include *Loudetia simplex*, *Panicum natalense*, and *Rhynchosia monophylla*.

c.28 *Selago atherstonei–Syzygium cordatum* Low Open Woodland

Occurring in Spitskop Forest Reserve on xeroclinal terraces and slopes (Figure 9). Differential and dominant species are indicated in Table 6 (Group E). Non-differential dominants include *Bequaertiodendron magalismontanum* and *Loudetia simplex*.

c.29 *Clutia monticola–Loudetia simplex* Low Open Woodland

Widespread on xeroclinal upper slopes. Differential species are indicated in Table 6 (Group F). Dominant species include *Helichrysum mimetes* and *Rhus tumulicola*.

3.3 Subhumid Mistbelt communities of exposed rocky upper slopes with less than 75 % vegetation cover

c.30 *Trachypogon spicatus–Rhus tumulicola* Low Open Woodland/Tall Open Shrubland

Confined to Klapperkop Quartzite outcrops on mesoclinal Summit Slopes, Hartebeestvlakte (Figure 10). Differential and dominant species are indicated in Table 6 (Group G). Non-differential dominants include *Protea caffra*.

c.31 *Festuca costata* var. *costata–Cliffortia nitidula* subsp. *pilosa* Short Closed/Open Shrubland

Occurring in association with Hekpoort Andesite outcrops on xeroclinal Summit Peaks, notably Mount Anderson. Differential and dominant species are indicated in Table 6 (Group H). Non-differential dominants include *Myrsine africana*, *Vaccinium exul*, *Helichrysum splendidum* and *Cliffortia nitidula* subsp. *pilosa*.

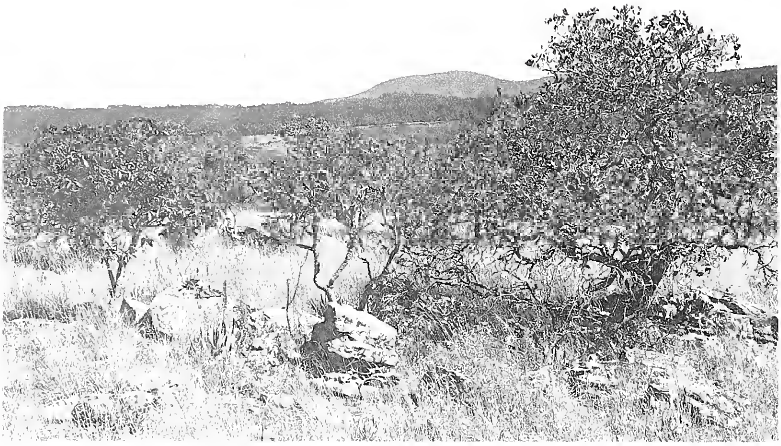

FIGURE 9.—*Selago atherstonei–Syzygium cordatum* Low Open Woodland of Black Reef Quartzite outcrops, Plateau Crest (c.28). *Aloe petricola* is visible bottom right and centre left.

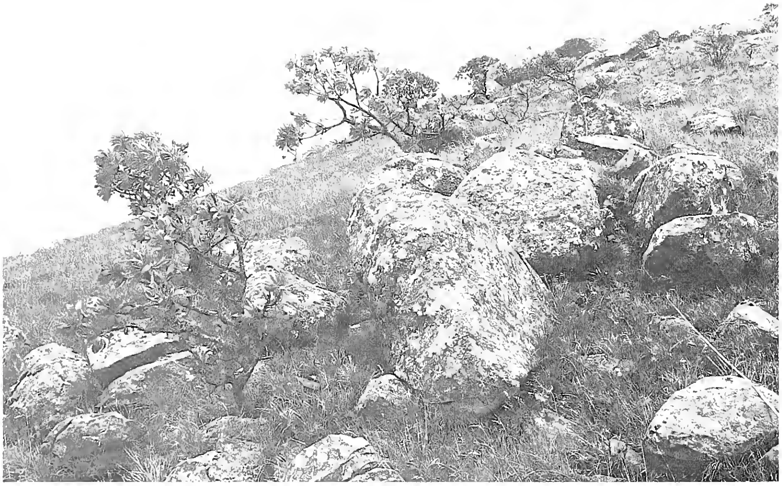

FIGURE 10.—*Trachypogon spicatus–Rhus tumulicola* Low Open Woodland associated with Klapperkop Quartzite outcrops, Summit Slopes (c.30). The conspicuous tree is *Protea caffra*.

FIGURE 11.—*Gunnera perpensa–Nidorella auriculata* Short Open (marshy) Shrubland on deep hydromorphic soils overlying Timeball Hill Shale (c.32). *Eucomis autumnalis* subsp. *clavata* and *Gunnera perpensa* are conspicuous.

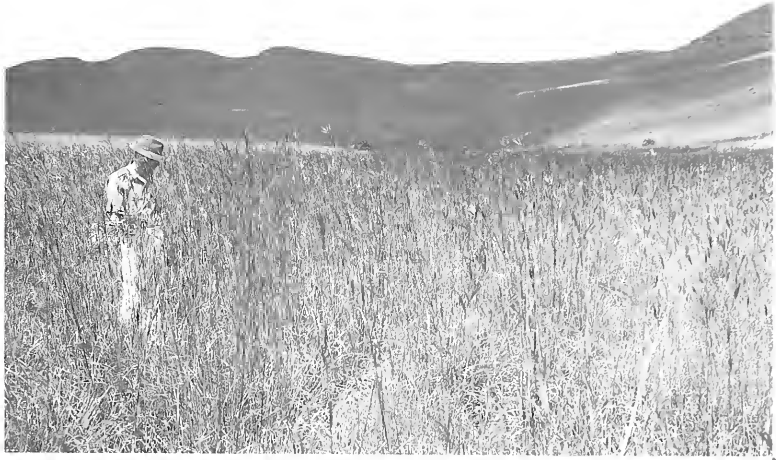

FIGURE 12.—Tall Closed (marshy) Grassland variant of Community 32. *Andropogon appendiculatus* is totally dominant.

3.4 Subhumid Mistbelt communities of marshes and stream banks with low rock cover and more than 75% vegetation cover, Summit Plateau

c.32 *Gunnera perpensa—Nidorella auriculata* Short Open (marshy) Shrubland/Tall Closed (marshy) Grassland

Confined to exposed, level terraces with deep hydromorphic alluvium overlying Timeball Hill Shale, Hartebeestvlakte (Figures 11 & 12). Differential and dominant species are indicated in Table 6 (Group I). Non-differential dominants include *Rabdosiella calycina*, *Nerine angustifolia* and *Andropogon appendiculatus*.

c.33 *Cyathea dregei—Hypericum revolutum* Low Open Woodland

Situated at Hartebeestvlakte on partly sheltered, mesoclinal stream banks with fairly shallow soils overlying Timeball Hill Shale or Klapperkop Quartzite (Figure 13). Differential and dominant species are indicated in Table 6 (Group J). Non-differential dominants include *Cliffortia nitidula* subsp. *pilosa*.

3.5 Subhumid Mistbelt communities of steep rocky kloofs in Timeball Hill Shale, Summit Slopes

c.34 *Aloe arborescens—Rhus pyroides* var. *gracilis* Low Bushland

Occurring in sheltered xeroclinal sites below Mount Anderson (Figure 14). Differential and dominant species are indicated in Table 6 (Group K). Non-differential dominants include *Hypericum revolutum*.

4 GRASSLAND OF THE MISTBELT

Associated communities are all fire-maintained, occurring on exposed sites with low rock cover. They are represented over all geological substrates. Table 7.

4.1 Humid Mistbelt grasslands of Escarpment Slopes overlying Nelspruit Granite (more than 75 % vegetation cover)

c.35 *Gladiolus densiflorus—Loudetia simplex* Short Closed Grassland

Notable at Hebron as relic patches on mesoclinal foot slopes with low rock cover. Differential and dominant species are indicated in Table 8 (Group A). Non-differential dominants include *Monocymbium ceresiiforme* and *Athanasia acerosa*.

c.36 *Cliffortia repens—Loudetia simplex* Short Open (grassy) Shrubland

Occurring as relic patches on xeroclinal upper slopes with moderate rock cover, Frankfort Forest Reserve. Differential and dominant species are indicated in Table 8 (Group B). Non-differential dominants include *Eragrostis capensis*, *Pearsonia sessilifolia* 'complex' and *Hemizygia subvelutina*.

4.2 Humid Mistbelt grasslands of Escarpment Plateau (less than 75 % vegetation cover)

c.37 *Tephrosia elongata—Monocymbium ceresiiforme* Low Closed Grassland

Situated in Mac-Mac Nature Reserve on xeroclinal terraces overlying Black Reef Quartzite with moderate rock cover. Differential species are indicated in Table 8 (Group C). Dominant species include *Bulbostylis schoenoides* and *Loudetia simplex*.

c.38 *Helichrysum cephaloideum—Monocymbium ceresiiforme* Low Closed Grassland

Confined to Mac-Mac Nature Reserve on xeroclinal terraces overlying Black Reef Quartzite with low rock cover (Figure 15). Differential species are indicated in Table 8 (Group D). Dominant species include *Rendlia altera*, *Loudetia simplex* and *Becium obovatum*.

c.39 *Wahlenbergia huttonii—Eragrostis racemosa* Low Closed Grassland

Situated around Sabie vicinity on xeroclinal terraces overlying Oaktree Dolomite with low rock cover. Differential species are indicated in Table 8 (Group E). Dominant species include *Loudetia simplex*, *Themeda triandra*, *Bulbostylis schoenoides* and *Helichrysum pilosellum*.

FIGURE 13.—*Cyathea dregei–Hypericum revolutum* Low Open Woodland in drainage lines of Summit Plateau (c.33).

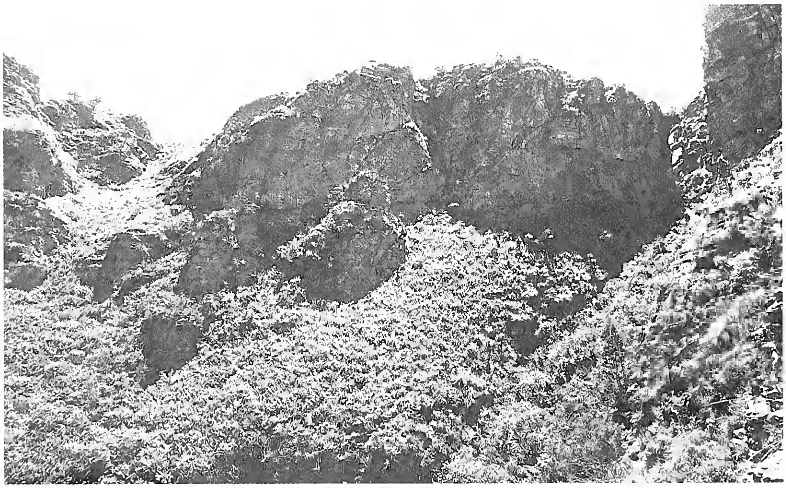

FIGURE 14.—*Aloe arborescens–Rhus pyroides* var. *gracilis* Low Bushland of steep rocky kloofs in Timeball Hill Formation, Summit Slopes (c.34).

FIGURE 15.—*Helichrysum cephaloideum–Monocymbium ceresiiforme* Low Closed Grassland of Escarpment Plateau (c.38). *Pteridium aquilinum* is dominant in patches.

TABLE 7.—Grassland of the Mistbelt: an ecological basis for the recognition of five habitat types (4.1–4.5) and 12 communities (c.35–c.46), confer Table 8

- Humid Mistbelt
  - (4.1) Escarpment Slopes; Nelspruit Granite; >75% vegetation cover
    - Mesoclinal footslopes; low rock cover (c.35)
    - Xeroclinal upper slopes; moderate rock cover (c.36)
  - (4.2) Escarpment Plateau <75% vegetation cover
    - Xeroclinal terrace
      - Black Reef Quartzite
        - Moderate rock cover (c.37) (c.40)
        - Low rock cover (c.38)
      - Oaktree Dolomite
        - Low rock cover (c.39)
    - Mesoclinal terrace
      - Black Reef Quartzite
        - Low rock cover (c.41)
  - (4.3) Lower Mountain Slopes; low rock cover; xeroclinal slopes
    - Upper Dolomite (c.42)
    - Bevet's Conglomerate (c.43)
- Subhumid Mistbelt
  - (4.4) Timeball Hill Shale; low rock cover; mesoclinal terraces & slopes
    - Summit Plateau (c.44)
    - Eroded Summit Plateau & Slopes (c.45)
  - (4.5) Hekpoort Andesite; high rock cover; xeroclinal upper slopes
    - Summit Peaks (c.46)

TABLE 8.—Floristic classification of Grassland of the Mistbelt

Habitat type	4.1		4.2					4.3		4.4		4.5
Community number	35	36	37	38	39	40	41	42	43	44	45	46
Total relevés per community	4	2	3	5	5	2	4	6	6	10	8	3
A. Differential species of Community 35												
* *Gladiolus densiflorus* (FB)	4				2							
Indigofera sp. (FB)	5											
Lopholaena disticha (FB)	4				1							
Aster comptonii (FB)	3							1				
Selago atherstonei (FB)	3								1			
B. Differential species of Community 36												
* *Cliffortia repens* (SH)		5										
Monopsis decipiens (FB)		5		1								
Styppeiochloa gynoglossa (GR)		5										
* *Helichrysum mimetes* (FB)		5						1			1	
Pycreus muricatus (CY)		5										
C. Differential species of Community 37												
Tephrosia elongata (FB)			4									
Microchloa caffra (GR)			4	1		3						
D. Differential species of Community 38												
Helichrysum cephaloideum (FB)				3								
Commelina sp. (FB)				4								
Senecio erubescens var. *crepidifolius* (FB)				3								
Senecio gerrardii (FB)				3								
Inulanthera calva (FB)				2				1				
Nidorella auriculata (SH)				2								
Drosera sp. (FB)				2								
Euphorbia striata (FB)				2								
E. Differential species of Community 39												
Wahlenbergia huttonii (FB)					4		2					2
Acrotome hispida (FB)					4		2		1			
Hyparrhenia hirta (GR)					4	3		1				
Brachiaria subulifolia (GR)					4							
Digitaria maitlandii (GR)					3							
Eriosema cordatum (FB)					3					1	1	
Hibiscus aethiopicus var. *ovatus* (FB)					3			1				
Pearsonia aristata (FB)					2		2					
Sonchus integrifolius (FB)					2							
Helichrysum harveyanum (FB)					2							
Senecio latifolius (FB)			2		4							
Triumfetta welwitschii var. *hirsuta* (FB)					3							
Hermannia lancifolia (FB)					3					1		
Scabiosa columbaria (FB)					2						1	
Hypoxis multiceps (FB)					2							
Gladiolus sp. (FB)	2				2							
Rhynchosia totta (LN)					2							
Raphionacme elata (FB)					2							
Sphenostylis angustifolia (LN)					2							
F. Differential species of Community 40												
* *Digitaria monodactyla* (GR)						5			1			
Anthericum galpinii (FB)						5						
Linum thunbergii (FB)						5						
Desmodium setigerum (FB)						5						
Ceratotheca triloba (FB)						5						
G. Differential species of Community 41												
Asclepias crassinervis (FB)					1		5	1				
Lopholaena segmentata (FB)							4	1				
Eriosema gunniae (FB)	2						3	1				
Pseudarthria hookeri var. *hookeri* (FB)							3	1				
Oxalis depressa (FB)							3	1	1			
Eriosema nutans (FB)							3					

* Dominant species. Digits 1–5 in matrix denote constancy values. For explanation of 'complex' see Deall & Backer (1989). Growth forms: TR = Tree; SH = Shrub; LN = Lianoid; EP = Epiphyte; FB = Forb or herb; CY = Sedge; GR = Grass; PT = Fern.

TABLE 8.—Floristic classification of Grassland of the Mistbelt (continued)

Habitat type	4.1		4.2					4.3		4.4		4.5
Community number	35	36	37	38	39	40	41	42	43	44	45	46
Total relevés per community	4	2	3	5	5	2	4	6	6	10	8	3
H. Differential species of Community 42												
Lippia javanica (SH)								5				
Flemingia grahamiana (FB)							2	5				
Rhus discolor (SH)							2	4				
Aristea woodii (FB)			4					3				
Rhus dentata (TR)						3		2				
Indigofera hilaris (FB)								3				
Cyphia elata 'complex' (FB)								2		1		
Crassula natalensis (FB)								2				
Heteromorpha pubescens (SH)								2				
Acalypha caperonioides (FB)								3		1		
Leonotis 'complex' (FB)								2				
Helichrysum mixtum (FB)								2				
I. Differential species of Community 43												
Indigofera sp. 1 (FB)									5			
**Protea caffra* (TR)	2								4	1		
Dicoma anomala subsp. *cirsioides* (FB)									2			2
Rhynchosia anguiosa (FB)									4			
Acalypha angustata var. *glabra* (FB)								1	4			
Cyperus obtusiflorus var. *flavissimus* (CY)									2			
Faurea speciosa (TR)	2								2			
J. Differential species of Community 44												
Helichrysum wilmsii (FB)		3								2		
Drosera burkeana (SH)										2		
Helichrysum glomeratum (FB)										1		
Helichrysum spiralepis (FB)										2		
Helichrysum subluteum (FB)										2	1	
Scleria dieterlenii (CY)										1		
Monsonia transvaalensis (FB)										2		
Clerodendrum triphyllum var. *triphyllum* (SH)										1		
K. Differential species of Community 45												
Eriosema kraussianum (FB)										1	3	
Protea gaguedi (TR)			2								2	
Gladiolus longicollis var. *platypetalus* (FB)										1	2	
Gnidia caffra (FB)											2	
Oxalis obliquifolia (FB)										1	2	
Sporobolus centrifugus (GR)											2	2
Vernonia thodei (FB)											2	
L. Differential species of Community 46												
**Erica atherstonei* (SH)												4
Hypoxis galpinii (FB)		3										4
Alepidea sp. (FB)												5
Hebenstretia comosa (FB)											1	4
Peucedanum sp. (FB)												4
Psammotropha myriantha (FB)												4

* Dominant species. Digits 1–5 in matrix denote constancy values. For explanation of 'complex' see Deall & Backer (1989). Growth forms: TR = Tree; SH = Shrub; LN = Lianoid; EP = Epiphyte; FB = Forb or herb; CY = Sedge; GR = Grass; PT = Fern.

c.40 *Digitaria monodactyla–Loudetia simplex* Low Closed Grassland

Notable in Sabie vicinity on xeroclinal terraces overlying Black Reef Quartzite with moderate rock cover. Differential and dominant species are indicated in Table 8 (Group F). Non-differential dominants include *Eragrostis capensis*.

c.41 *Asclepias crassinervis–Andropogon schirensis* Short Closed Grassland

Situated on mesoclinal terraces overlying Black Reef Quartzite with low rock cover, notably in Spitskop Forest Reserve. Differential species are indicated in Table 8 (Group G). Dominant species include *Themeda triandra*.

4.3 Humid Mistbelt grasslands of Lower Mountain Slopes

c.42 *Lippia javanica–Loudetia simplex* Short Closed Grassland/Tall Open Shrubland

Occurring on xeroclinal slopes overlying Upper Dolomite with low rock cover, Vertroosting Nature Reserve. Differential species are indicated in Table 8 (Group H). Dominant species include *Themeda triandra* and *Hemizygia transvaalensis*.

c.43 *Indigofera* sp.*–Monocymbium ceresiiforme* Low Closed Grassland/Sparse Woodland

Notable in Vertroosting Nature Reserve on xeroclinal upper slopes overlying Bevet's Conglomerate with low

FIGURE 16.—*Helichrysum wilmsii—Andropogon schirensis* Low Closed Grassland of Summit Plateau (c.44). *Sopubia cana* var. *cana* is the dominant forb.

rock cover. Differential and dominant species are indicated in Table 8 (Group I). Non-differential dominants include *Themeda triandra*, *Loudetia simplex* and *Eriosema ellipticifolium*.

4.4 Subhumid Mistbelt grasslands overlying Timeball Hill Shale with low rock cover and mesoclinal aspect

c.44 *Helichrysum wilmsii—Andropogon schirensis* Low Closed Grassland

Situated on terraces and slopes of the Summit Plateau, Hartebeestvlakte (Figure 16). Differential species are indicated in Table 8 (Group J). Dominant species include *Festuca costata* var. *costata*, *Themeda triandra*, *Alloteropsis semialata* subsp. *eckloniana*, *Loudetia densispica* and *Sopubia cana* var. *cana*.

c.45 *Eriosema kraussianum—Rendlia altera* Low Closed Grassland

Occurring on eroded terraces and slopes of the Summit Plateau and Summit Slopes, Hartebeestvlakte (Figure 17). Differential species are indicated in Table 8 (Group K). Dominant species include *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon schirensis*, *Festuca costata* var. *costata*, *Monocymbium ceresiiforme* and *Loudetia densispica*.

4.5 Subhumid Mistbelt grasslands overlying Hekpoort Andesite with high rock cover and xeroclinal aspect

c.46 *Erica atherstonei—Harpochloa falx* Low Closed Grassland/Open (grassy) Shrubland

Confined to upper slopes of the Summit Peak, at Mount Anderson. Differential and dominant species are indicated in Table 8 (Group L). Non-differential dominants include *Rendlia altera*, *Festuca costata* var. *costata*, *Protea parvula* and *Erica cerinthoides* var. *cerinthoides*.

CONCLUSION

At the finest level of detail, the classification of vegetation in the Sabie area has elicited 46 floristic entities

FIGURE 17.—*Eriosema kraussianum—Rendlia altera* Low Closed Grassland of eroded terraces and slopes, Summit (c.45).

(communities), defined on the basis of differential species. Environmental correlation enhances the descriptive and predictive value of the classification. As a planning and management tool, however, it is obviously incomplete. Aspects such as causality and community function must yet be investigated in association with relevant key questions. The floristic classification presented here should provide a basis for such investigation.

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The vegetation ecology of the Eastern Transvaal Escarpment in the Sabie area. 3. Annotated checklist

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Keywords: Checklist, Eastern Transvaal Escarpment, Sabie area

ABSTRACT

Over 1 000 plant taxa occurring in a 1 300 km² belt transect extending from Hazyview (530 m elevation) to Mount Anderson (2 280 m elevation) in the Sabie area of the Eastern Transvaal Escarpment are listed by genus, with species arranged alphabetically within genera. Annotations include genus author, species author, growth form, habitat, collector and specimen number. Floristic analysis shows the Asteraceae as representing the largest family, followed by the Fabaceae, Poaceae, Rubiaceae and Liliaceae. Floristic affinities are briefly discussed.

UITTREKSEL

In 'n 1 300 km² breë lynopname, wat vanaf Hazyview (530 m bo seespieël) tot Mount Anderson (2 280 m bo seespieël) in die Sabie-area van Oos-Transvaalse platorand strek, kom meer as 1 000 planttaksons voor wat volgens genus gelys is. Die spesies is alfabeties onder die genusse gerangskik. Aantekeninge sluit die genus-outeur, spesie-outeur, groeivorm, habitat, versamelaar en eksemplaarnommer in. Volgens die floristiese analise verteenwoordig die Asteraceae die grootste familie gevolg deur Fabaceae, Poaceae, Rubiaceae en Liliaceae. Floristiese verwantskappe word ook kortliks bespreek.

INTRODUCTION

This checklist contains 1 009 identifiable plant taxa (excluding mosses and lichens) recorded in the 251 relevés of the study area (cf. Deall *et al.* 1989a & b). Most taxa are represented by voucher specimens housed in either the National Herbarium, Pretoria; the D. R. de Wet Forestry Research Centre Herbarium, Sabie; or in the senior author's field herbarium, Botanical Research Institute, Pretoria. A number of plants seen in the field are not included in the checklist because they were in too poor a condition to be identified. Voucher specimen numbers are italicized at the end of each species citation. All pertain to G. B. Deall except where indicated. Some taxa can, if necesary, be verified by more than the single voucher specimen quoted. Additional numbers are available from the senior author's collection register kept at the National Herbarium, Pretoria.

Classification of the Pteridophyta is according to Schelpe & Anthony (1986) and that of the Spermatophyta is according to Gibbs Russell *et al.* (1985, 1987). Species are arranged alphabetically within genera, exotic species being indicated by an asterisk. In instances where plants could not be identified below the generic level, the epithet sp. is appended (e.g. *Combretum* sp.). It should be noted that such a name may not consistently refer to the same species concept, but may include various species within the genus. Also, species designated as 'complex' are those whose identity in the field was not clear. For example, *Tetradenia* 'complex' is named thus because, although the first specimens collected were identified as *Tetradenia riparia,* subsequent specimens, which cursorily appeared to be *T. riparia* were identified as *T. brevispicata*. This distinction could not easily be discerned in the field without prior knowledge, and thus the term 'complex' is used to indicate that either species could be involved. Annotative terminology is in accordance with the categories used by Deall *et al.* (1989a & b).

FLORISTIC ANALYSIS

A floristic analysis of the taxa contained in the checklist is summarized in Table 1. The study revealed a total of 1 009 identifiable species (including subspecies and varieties) distributed amongst 501 genera and 133 families. As with Scheepers' (1978) study, the Asteraceae constitute the largest family (37 genera and 128 species). The Fabaceae (36 genera, 91 species) and Poaceae (49 genera, 90 species) are next, followed by the Rubiaceae (26 genera, 48 species) and Liliaceae (21 genera, 46 species). The largest genera include *Helichrysum* (39

TABLE 1.—Floristic analysis of taxa in the Sabie area of the Eastern Transvaal Escarpment

Major families and groups	No. of families	No. of genera	No. of species*
Monocotyledonae	16	126	244
Poaceae		49	90
Liliaceae		21	46
Dicotyledonae	95	345	709
Asteraceae		37	128
Fabaceae		36	91
Rubiaceae		26	48
Angiospermae	111	471	953
Gymnospermae	2	2	3
Pteridophyta	20	28	53
	133	501	1 009

* including subspecies and varieties

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spp.), *Senecio* (21 spp.), *Vernonia* (12 spp.), *Asplenium* (11 spp.), *Cyperus* (11 spp.), *Rhynchosia* (10 spp.), *Indigofera* (9 spp.), *Crassula* (9 spp.), *Protasparagus* (9 spp.), and *Hyparrhenia* (9 spp.).

Of the species whose distribution is limited to the Montane and Subalpine Belts, 29 % are present in the Natal Drakensberg (Killick 1963); 28 % in the northern Transvaal Drakensberg (Scheepers 1978); and 17 % in the Chimanimani Mountains of Zimbabwe (Goodier & Phipps 1961). This suggests that the Montane and Subalpine flora of the Sabie area has both temperate and tropical affinites, although the former is apparently stronger.

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CHECKLIST

PTERIDOPHYTA

LYCOPODIACEAE
Lycopodium *L.*
gnidioides *L. f.*, trailing, on rocks in elfin-like Mistbelt forests, *1194*

SELAGINELLACEAE
Selaginella *Beauv.*
dregei *(Presl) Hieron.*, mat-forming xerophytic pioneer in rock depressions of Escarpment Slopes and Foothills, *1618*
kraussiana *(Kunze) A. Br. ex Kuhn*, prostrate moss-like species in field layer of Tall Forest, Escarpment and Mountain Slopes, *326*

MARATTIACEAE
Marattia *Swartz*
fraxinea *J.E. Sm. ex J.F. Gmel.* var. salicifolia *(Schrad.) C. Chr.*, large waterside fern in dense shade of Tall (riparian) Forest, Mountain Slopes and Upper Foothills, *1043*

OSMUNDACEAE
Todea *Willd. ex Bernh.*
barbara *(L.) T. Moore*, large tree-like fern of Tall (swamp) Forest, Escarpment Lower Slopes, *1120*

GLEICHENIACEAE
Dicranopteris *Bernh.*
linearis *(Burm. f.) Underw.*, infrequent fern in forests and mesic thickets of Foothills, *571*

SCHIZAEACEAE
Mohria *Swartz*
caffrorum *(L.) Desv.*, rosette fern associated with rocky woodlands and grasslands of Mistbelt, *1023*

CYATHEACEAE
Cyathea *J.E. Sm.*
dregei *Kunze*, large tree fern in moist (often riparian) sites of Mistbelt and Low Country, *109*

HYMENOPHYLLACEAE
Trichomanes *L.*
pyxidiferum *L.* var. melanotrichum *(Schlechtd.) Schelpe*, small-lobed transluscent epiphyte of Mistbelt forests, *1017*

DENNSTAEDTIACEAE
Blotiella *Tryon*
glabra *(Bory) Tryon*, large tree-like fern of Tall (swamp) Forest, Escarpment Lower Slopes, *1126*
Pteridium *Gled. ex Scop.*
aquilinum *(L.) Kuhn*, widespread fern of disturbed grasslands and thickets, especially Mistbelt, *29*
Hypolepis *Bernh.*
sparsisora *(Schrad.) Kuhn*, large bracken-like fern in sunny openings of Mistbelt forests, *1123*

ADIANTACEAE
Adiantum *L.*
capillus-veneris *L.*, infrequent waterside fern in forests of Mistbelt and Low Country, *894*
Pteris *L.*
catoptera *Kunze*, large fern in field layer of moist forests, Humid Mistbelt, *1063*
cretica *L.*, large fern in Tall (riparian) Forest, Mountain Slopes, *1572*
Cheilanthes *Swartz*
concolor *(Langsd. & Fisch.) R. & A. Tryon*, apparently rare streambank fern in riparian forests of Low Country, *1846*
hirta *Swartz*, occasional fern in rocky, sheltered mesic thickets of Low Country, *1717*
pentagona *Schelpe & N.C. Anthony*, small localized fern of rock outcrops in Summit Peak grasslands and shrublands, *2495*
quadripinnata *(Forssk.) Kuhn*, localized fern of Summit shrublands and woodlands, *2293*
viridis *(Forssk.) Swartz*
var. glauca *(Sim) Schelpe & N.C. Anthony*, fern of exposed rocky sites in grasslands and thickets of Humid Mistbelt, *1414*
var. viridis, widespread rosette fern, common in Mistbelt and Low Country, *2077*
Pellaea *Link*
calomelanos *(Swartz) Link*, rosette fern, common on rock outcrops in woodlands and shrublands of Mistbelt and Low Country, *87*
pectiniformis *Bak.*, rosette fern associated with rock outcrops in forests and woodlands of Humid Mistbelt, *1391*

POLYPODIACEAE
Polypodium *L.*

polypodioides *(L.) Hitchc.*, subsp. ecklonii *(Kunze) Schelpe*, creeping epiphytic fern, common in Mistbelt forests, *704*

Pleopeltis *H.B.K. ex Willd.*

macrocarpa *(Bory ex Willd.) Kaulf.*, creeping epiphytic fern, common in Mistbelt forests, *717*

DAVALLIACEAE

Arthropteris *J. Sm.*

monocarpa *(Cordem.) C. Chr.*, infrequent shade fern associated with exposed (rocky) woodlands of Plateau Crest, *1400*

ASPLENIACEAE

Asplenium *L.*

aethiopicum *(Burm. f.) Becherer*, occasional fern in deep bushy ravines, Summit Slopes, *2677*

anisophyllum *Kunze*, robust epiphytic fern in forests of Humid Mistbelt, *1065*

boltonii *Hook. ex Schelpe*, small fern in High Forest of Mountain Slopes, *2172*

erectum *Bory ex Willd.* var. erectum, ground fern in field layer of high Mistbelt forests, *2138*

inaequilaterale *Willd.*, occasional fern in rocky field layer of Mistbelt forests, *1130A*

lobatum *Pappe & Rawson*, occasional fern in rocky field layer of Mistbelt forests, *1046A*

lunulatum *Swartz*, fern in dense shade of tall Mistbelt forests, *1130*

rutifolium *(Berg.) Kunze*, common epiphytic fern in Mistbelt forests, *335*

sandersonii *Hook.*, small epiphytic fern in moist forest of Lower Mountain Slopes, *2230*

splendens *Kunze*, common epiphytic or ground fern in Mistbelt forests, *321*

varians *Wall. ex Hook. & Grev.* subsp. fimbriatum *(Kunze) Schelpe*, apparently confined to cool, moist cliff forests of Lower Mountain Slopes, *1380*

THELYPTERIDACEAE

Thelypteris *Schmidel*

bergiana *(Schlechtd.) Ching*, rosette fern, infrequent along shady stream banks in forests of Mistbelt and Low Country, *895*

gueinziana *(Mett.) Schelpe*, large fern in Tall (riparian) Forest of Low Country, *1909*

interrupta *(Willd.) K. Iwats.*, large infrequent fern in Tall (riparian) Forest of Low Country, *1923*

madagascariensis *(Fée) Schelpe*, rosette fern in tall Mistbelt forests, especially Escarpment Slopes, *1122*

sp., large fern in Tall Forest of Escarpment Slopes, includes *1045*

ATHYRIACEAE

Athyrium *Roth*

scandicinum *(Willd.) Presl*, small infrequent fern in Tall (riparian) Forest of Escarpment Lower Slopes, *1125*

LOMARIOPSIDACEAE

Elaphoglossum *Schott ex J. Sm.*

acrostichoides *(Hook. & Grev.) Schelpe*, fern in shelter of large boulders, Summit Peak shrublands, *2496*

ASPIDIACEAE

Dryopteris *Adans.*

athamantica *(Kunze) Kuntze*, rosette fern in marshy grasslands, especially Mistbelt, *1655*

inaequalis *(Schlechtd.) Kuntze*, frequent rosette fern of Mistbelt forests, *1001*

Cyrtomium *Presl*

caryotideum *(Wall. ex Hook. & Grev.) Presl.* var. micropterum *(Kunze) C. Chr.*, infrequent fern in forests of Humid Mistbelt, *1575*

Polystichum *Roth*

luctuosum *(Kunze) T. Moore*, infrequent fern in forests of Humid Mistbelt, especially Lower Mountain Slopes, *1381*

macleae *(Bak.) Diels*, large leathery fern, infrequent in Tall (riparian) Forest, Summit Slopes, *2260*

Rumohra *Raddi*

adiantiformis *(G. Forst.) Ching*, robust fern apparently confined to rocky outcrops in forest openings, especially Plateau Crest, *1226*

Tectaria *Cav.*

gemmifera *(Fée) Alston*, fairly infrequent fern in Tall Forest of Escarpment Slopes, *1139*

BLECHNACEAE

Blechnum *L.*

giganteum *(Kaulf.) Schlechtd.*, fairly infrequent fern in Tall Forest of Escarpment Slopes, *1121*

tabulare *(Thunb.) Kuhn*, large rosette fern widespread in Mistbelt woodlands and grasslands, *1146*

GYMNOSPERMAE

PODOCARPACEAE

Podocarpus *L'Hérit.*

falcatus *(Thunb.) R. Br. ex Mirb.*, tall understorey and canopy tree, sometimes dominant in High Forest of Mountain Slopes, *2223*

latifolius *(Thunb.) R. Br. ex Mirb.*, dominant canopy tree in elfin-like forests, Plateau Crest and Mountain Slopes, *2050*

PINACEAE

*Pinus *L.*

spp., exotic timber tree encroaching on indigenous vegetation wherever plantations exist

ANGIOSPERMAE — MONOCOTYLEDONAE

TYPHACEAE

Typha *L.*

capensis *(P. Rohrb.) N.E. Br.*, robust rhizomatous herb on stream banks in Low Country, *Scheepers 12*

POACEAE

Ischaemum *L.*

fasciculatum *Brongn.*, localized in marshy grasslands of Escarpment Lower Slopes and Foothills, *1905*

Elionurus *Kunth ex Willd.*

sp., small tufted perennial grass of Summit Plateau grasslands, *2741*

Cleistachne *Benth.*

sorghoides *Benth.*, occasional annual grass in xeric thickets of Upper Foothills, *684*

Eulalia *Kunth.*

villosa *(Thunb.) Nees*, widespread tufted perennial grass in thickets, woodlands and grasslands of Mistbelt and Low Country, *633*

Bothriochloa *Kuntze*

bladhii *(Retz.) S.T. Blake*, widespread perennial grass in disturbed grasslands and woodlands of Low Country, *598*

Schizachyrium *Nees*

sanguineum *(Retz.) Alston*, widespread tufted grass in woodlands and grasslands of Mistbelt and Low Country, *603*

Andropogon *L.*

appendiculatus *Nees*, tall perennial grass dominating hygric sites with deep black soils, Summit Slopes and Plateau, *2580*

chinensis *(Nees) Merr.*, small tufted perennial grass, infrequent in grasslands and woodlands of Low Country, *1919*

huillensis *Rendle*, large tufted perennial grass, infrequent in disturbed grasslands, especially Mistbelt, *1300*

schirensis *A. Rich.*, medium-size tufted perennial grass, abundant (often dominant) in woodlands and grasslands of Mistbelt, *1321B*

Cymbopogon *Spreng.*

'complex', tall tufted perennial grass in thickets, woodlands and grasslands of Mistbelt and Low Country:

excavatus *(Hochst.) Stapf ex Burtt Davy, 1518*

validus *(Stapf) Stapf ex Burtt Davy, 1321C*

Hyparrhenia *Anderss. ex Fourn.*

anamesa *Clayton*, robust tufted perennial grass, infrequent in moist grasslands, Humid Mistbelt, *1658*

cymbaria *(L.) Stapf*, large tufted perennial grass in seral thickets and woodlands, Humid Mistbelt, *1601*

dregeana *(Nees) Stapf ex Stent*, large tufted perennial grass in rocky open woodlands of Humid Mistbelt, *1977*

filipendula *(Hochst.) Stapf*
' complex', tufted perennial grass, common in thickets, woodlands and grasslands of Mistbelt and Low Country:
var. filipendula, *1321F*
var. pilosa *(Hochst.) Stapf, 1624A*
gazensis *(Rendle) Stapf*, tufted perennial grass, localized in fairly rocky woodlands and thickets of Low Country, *84c.*
hirta *(L.) Stapf*, fairly frequent tufted perennial grass in woodlands and grasslands of Mistbelt and Low Country, *1321D*
newtonii *(Hack.) Stapf* var. macra *Stapf*, infrequent perennial grass associated with seepage areas, Escarpment Slopes, *164*
variabilis *Stapf*, tall perennial grass in woodlands of Low Country, *3*
Hyperthelia *Clayton*
dissoluta *(Nees ex Steud.) Clayton*, large tufted grass, widespread in Woodland and Xeric Thicket of the Low Country, *2018*
Monocymbium *Stapf*
ceresiiforme *(Nees) Stapf*, small tufted perennial grass, abundant in grasslands of Mistbelt, *1119*
Trachypogon *Nees*
spicatus *(L. f.) Kuntze*, frequent tufted perennial grass scattered in woodlands and grasslands of Mistbelt and low Country, *1513*
Heteropogon *Pers.*
contortus *(L.) Roem. & Schult.*, small tufted perennial grass, widespread in Woodland and Xeric Thicket of the Low Country, *730*
Diheteropogon *Stapf*
amplectens *(Nees) Clayton*, large tufted perennial grass, infrequent in disturbed woodlands of Upper Foothills, *623*
filifolius *(Nees) Clayton*, small tufted perennial grass, scattered in Summit grasslands, *1694*
Themeda *Forssk.*
triandra *Forssk.*, widespread tufted perennial grass in thickets, woodlands and grasslands of Mistbelt and Low Country, *745*
Digitaria *Haller*
diagonalis *(Nees) Stapf* var. diagonalis, tufted perennial grass, occasional in Mountain Slopes grasslands, *1533*
maitlandii *Stapf & C.E. Hubb.*, tufted perennial grass in deep-soil grasslands of Plateau Interior, *1312*
monodactyla *(Nees) Stapf*, small tufted perennial grass in rocky retarded grasslands, especially Escarpment Plateau, *1276*
tricholaenoides *Stapf*, rare rhizomatous perennial grass in Plateau grasslands, Humid Mistbelt, *1244A*
Alloteropsis *C.B. Presl*
semialata *(R. Br.) Hitchc.*, small tufted perennial grass, common in Escarpment Plateau and Summit grasslands, *1113*
Brachiaria *Griseb.*
brizantha *(A. Rich.) Stapf*, infrequent grass in disturbed grasslands of Low Country, *721*
serrata *(Thunb.) Stapf*, infrequent tufted perennial grass, sometimes associated with sheet-rock outcrops on Upper Foothills, *1320A*
subulifolia *(Mez) Clayton*, localized grass in dolomite-soil grasslands, Plateau Interior, *1320*
Paspalum *L.*
scrobiculatum *L.*, infrequent perennial grass of disturbed grasslands and woodlands, Mistbelt and Low Country, *678*
*urvillei *Steud.*, naturalized perennial grass, infrequent in disturbed woodlands, Low Country, *114*
Oplismenus *Beauv.*
hirtellus *(L.) Beauv.*, low straggling perennial grass, widespread and dominant in field layer of Forest and Mesic Thicket of Mistbelt and Low Country, *682*
Panicum *L.*
'complex', common grass in field layer of Woodland and Xeric Thicket of Low Country:
deustum *Thunb., 1695A*
maximum *Jacq., 847*
ecklonii *Nees*, tufted perennial grass, widespread in Mistbelt grasslands, *1096*
natalense *Hochst.*, widespread tufted perennial grass in Mistbelt grasslands and woodlands, *1321H*
Setaria *Beauv.*
megaphylla *(Steud.) Dur. & Schinz*, robust tufted perennial grass, widespread in forests and mesic woodlands and thickets of Mistbelt and Low Country, *602*
sphacelata *(Schumach.) M.B. Moss*, medium-size tufted grass, widespread in Humid Mistbelt grasslands and woodlands and in Low Country woodlands and xeric thickets, *817*
Rhynchelytrum *Nees*
'complex', small tufted grass, widespread in Woodland and Xeric Thicket of Low Country and in Mistbelt woodlands and grasslands:
nerviglume *(Franch.) Chiov., 1292B*
repens *(Willd.) C.E. Hubb., 1401*
rhodesianum *(Rendle) Stapf & C.E. Hubb., 1623*
Melinis *Beauv.*
tenuinervis *(Stapf) Stapf*, rare tufted grass in closed (rocky) woodlands, Low Country, *1704*
Pennisetum *Rich.*
macrorum *Trin.*, tall perennial grass of riparian woodlands, Summit Plateau, *2710*
thunbergii *Kunth*, tufted rhizomatous perennial grass of marshy grasslands, Summit Plateau, *2652*
Ehrharta *Thunb.*
erecta *Lam.*, sporadic straggly perennial grass in Mistbelt forests and thickets, *243*
Tristachya *Nees*
leucothrix *Nees*, tufted perennial grass scattered in woodlands and grasslands of Mistbelt, *1321J*
Trichopteryx *Nees*
dregeana *Nees*, short straggling perennial grass, usually associated with seepage, Mistbelt, *1108*
Loudetia *Hochst. ex Steud.*
densispica *(Rendle) C.E. Hubb.*, tufted perennial grass confined to woodlands and grasslands of Mistbelt, *1094*
simplex *(Nees) C.E. Hubb*, tufted perennial grass, dominant in Humid Mistbelt grasslands and woodlands and also present in Low Country woodlands, shrublands and thickets, *616*
Helictotrichon *Bess. ex Schult.*
natalense *(Stapf) Schweick.*, locally abundant perennial grass of marshy grasslands, Summit Plateau, *2659*
Pentaschistis *Stapf*
sp., tufted perennial grass, infrequent in grasslands of Summit Peaks, *2733*
Phragmites *Trin.*
mauritianus *Kunth*, tall robust perennial reed in dense stands along rivers in Low Country, *1965*
Agrostis *L.*
eriantha *Hack.* var. eriantha, infrequent grass localized in shrubby grasslands, Summit Plateau, *2647*
lachnantha *Nees*, loosely tufted perennial grass, infrequent in grasslands of Escarpment Slopes, *1078*
Aristida *L.*
congesta *Roem. & Schult.* subsp. barbicollis *(Trin. & Rupr.) De Winter*, small tufted grass, infrequent in Low Country woodlands, *1767*
junciformis *Trin. & Rupr.* subsp. junciformis, small tufted grass, infrequent in rocky grasslands of Plateau Crest and Summit, *1428*
transvaalensis *Henr.*, tufted grass in moist seepage of sheet-rock formations, Transitional Mistbelt, *1621*
Perotis *Ait.*
patens *Gand.*, small grass, infrequent in Low Country woodlands, *1760*
Sporobolus *R. Br.*
centrifugus *(Trin.) Nees*, densely tufted perennial grass, fairly frequent on Summit Peaks and Slopes, *2371*
'complex', tufted grass, widespread in Mistbelt grasslands and in woodlands and shrublands of Low Country:
africanus *(Poir.) Robyns & Tournay, 1541*
pyramidalis *(Beauv.), 555*
sp., *972*
stapfianus *Gand*, small tufted grass localized and infrequent on sheet-rock formations in Mistbelt and Low Country, *1898*
Eragrostis *Beauv.*
caesia *Stapf*, tufted perennial grass, localized in sandy grasslands of Plateau Crest, *54*
capensis *(Thunb.) Trin.*, widespread tufted perennial grass in grasslands of Escarpment Slopes and Plateau, *1097*
curvula *(Schrad.) Nees*, widespread tufted perennial grass, except in forests and mesic thickets, *1294B*
gummiflua *Nees*, infrequent grass of disturbed sheet-rock sites, Humid Mistbelt, *1299A*

hierniana *Rendle*, infrequent grass on sheet-rock formations in Mistbelt and Low Country, *1920*
racemosa *(Thunb.) Steud.*, widespread tufted perennial grass in grasslands of Mistbelt, *1028*
sclerantha *Nees* subsp. sclerantha, localized grass of lithoseral grasslands, especially Mistbelt, *1424A*
Microchloa *R. Br.*
caffra *Nees*, small tufted perennial grass, localized in lithoseral grasslands of Mistbelt and Low Country, *1143*
Rendlia *Chiov.*
altera *(Rendle) Chiov.*, small tufted perennial grass, locally abundant in grasslands of Summit and Plateau Crest, *1171*
Harpochloa *Kunth*
falx *(L. f.) Kuntze*, tufted perennial grass in sandy grasslands of Escarpment Slopes, Plateau Crest and Summit Peak, *1208*
Ctenium *Panz.*
concinnum *Nees*, large tufted perennial grass, infrequent in grasslands of Summit and Mountain Slopes, *1511*
Pogonarthria *Stapf*
squarrosa *(Roem. & Schult.) Pilg.*, tufted grass, rare in sandy woodlands of Low Country, *1769*
Bewsia *Goossens*
biflora *(Hack.) Goossens*, tufted perennial grass in grasslands of Lower Mountain Slopes, *1312G*
Styppeiochloa *De Winter*
gynoglossa *(Goossens) De Winter*, small tufted perennial grass, confined to grasslands of Escarpment Slopes, *1102*
Trichoneura *N.J. Anderss.*
grandiglumis *(Nees) Ekman*, small tufted grass, rare in sandy woodlands of Low Country, *1759*
Koeleria *Pers.*
capensis *(Steud.) Nees*,densely tufted perennial grass in rocky woodlands and grasslands of Mistbelt, *1079*
Stiburus *Stapf*
alopecuroides *(Hack.) Stapf*, small tufted perennial grass, localized in sandy grasslands of Escarpment and Summit Plateau, *1109*
Festuca *L.*
caprina *Nees* var. caprina, infrequent tufted perennial grass of Summit Peak grasslands, *2509*
costata *Nees* var. costata, densely tufted perennial grass, often dominant in Summit grasslands, *2619*
Bromus *L.*
speciosus *Nees*, scattered tufted perennial grass of Summit grasslands, *2618*

CYPERACEAE
Cyperus *L.*
albostriatus *Schrad.*, common sedge in field layer of forests, mesic thickets and rocky woodlands, especially Mistbelt, *1418*
denudatus *L. f.*, occasional sedge of marshy grasslands, Summit Plateau, *2575*
immensus *C.B. Cl.*, robust sedge, infrequent in Tall (riparian) Forest of Low Country, *1908*
leptocladus *Kunth*, apparently localized sedge in rocky woodlands and grasslands, Escarpment Plateau, *1289*
obtusiflorus *Vahl*
var. flavissimus *Boeck.*, localized sedge in grasslands of Lower Mountain Slopes, *1478*
var. sphaerocephalus *(Vahl) Kuekenth.*, frequent sedge of Summit grasslands, *2512*
pseudoleptocladus *Kukenth.*. medium size sedge, widespread in Forest and Mesic Thicket of Mistbelt and Low Country, *1056*
schlechteri *C.B. Cl.*, infrequent sedge of moist grasslands, Summit Plateau, *2687*
semitrifidus *Schrad.*, small sedge, widespread in lithoseral grasslands of Escarpment Plateau and Summit, *1278*
sexangularis *Nees*, infrequent sedge in field layer of Tall (riparian) Forest, Low Country, *1841*
thorncroftii *McClean*, sedge of sheet-rock shrublands, Transitional Mistbelt, *1620*
Pycreus *Beauv.*
muricatus *(Kukenth.) Napper*, small sedge, localized in grasslands of Escarpment Slopes, *1077*
Mariscus *Gaertn.*
solidus *(Kunth) ined.* subsp. solidus, giant sedge of marshy grasslands, Transitional Mistbelt, *1969*
Kyllinga *Rottb.*
alba *Nees*, small sedge of Escarpment Plateau grasslands, *161*
odorata *Vahl*, small sedge, infrequent in Mistbelt grasslands, *Scheepers 19*
Ficinia *Schrad.*
bergiana *Kunth*, small sedge, infrequent in grasslands of Lower Mountain Slopes, *1501*
sp., tussock sedge, Mistbelt and Low Country, includes *680, 2527*
Scirpus *L.*
ficinioides *Kunth*, locally abundant sedge of marshy grasslands, Summit and Escarpment Plateau, *1262A*
Schoenoplectus *Palla*
corymbosus *(Roth. ex Roem. & Schult.) J. Raynal*, waterside sedge, localized in Tall (riparian) Forest of Low Country, *1910*
Bulbostylis *Kunth*
burchellii *(Fical. & Hiern) C.B. Cl.*, occasional sedge in rocky woodlands of Plateau Crest, *1449*
oritrephes *(Ridley) C.B. Cl.*
'complex', small tufted sedge common in Summit grasslands and shrublands:
subsp. australis *B.L. Burtt*, *2389*
subsp. oritrephes, *2326*
schoenoides *(Kunth) C.B. Cl.*, small sedge, widespread in grasslands of Escarpment Plateau and Slopes, *1088*
Rhynchospora *Vahl*
brownii *Roem. & Schult.*, occasional sedge associated with seepages in woodlands and grasslands of Transitional Mistbelt, *749*
Tetraria *Beauv.*
natalensis *(C.B. Cl.) Koyama*, localized sedge of moist grasslands, Summit Slopes, *2394*
cf. sp. nov. *(De Winter & Codd 202)*, occasional perennial herb of moist rocky woodlands and shrublands, Summit Slopes, *2368, 2427*
Coleochloa *Gilly*
setifera *(Ridley) Gilly*, large-tussocked sedge, locally abundant on sheet-rock formations, Mistbelt and Low Country, *1882*
Scleria *Berg.*
bulbifera *Hochst. ex A. Rich.*, infrequent sedge of Escarpment Plateau grasslands, *1335*
dieterlenii *Turrill*, small perennial sedge of moist grasslands, Summit Plateau and Slopes, *2563*
melanomphala *Kunth*, occasional sedge of moist grasslands, Escarpment Lower Slopes, *1944*
Schoenoxiphium *Nees*
lehmannii *(Nees) Steud.*, infrequent perennial sedge of Tall (riparian) Forest, Lower Mountains, *1582*
rufum *Nees*, tufted perennial sedge, infrequent in riparian woodlands, Summit Plateau, *2444*
schweickerdtii *Merxm. & Podlech*, rhizomatous perennial sedge of rock crevices, Summit Peak, *2469*
sp. nov., tufted sedge of riparian woodlands, Summit Plateau, *2435*
Carex *L.*
austro-africana *(Kukenth.) Raymond*, waterside sedge of marshy grasslands, Summit Plateau, *2578*
cognata *Kunth.* var. drakensbergensis *(C.B. Cl.) Kukenth.*, waterside sedge, Summit Plateau, *2443*
spicato-paniculata *C.B. Cl.*, fairly widespread sedge in forests, thickets and woodlands of Mistbelt and Low Country, *595*

ARECACEAE
Phoenix *L.*
reclinata *Jacq.*, small tree on stream banks of High (riparian) Forest, Low Country, *1838*

ARACEAE
Zantedeschia *Spreng.*
sp., infrequent perennial herb of marshy grasslands, Summit Plateau, (no voucher specimen)
Stylochiton *Lepr.*
natalense *Schott*, perennial tufted herb, localized in shaded field layer of forests, thickets and woodlands, Low Country, *702*

XYRIDACEAE
Xyris *L.*
gerrardii *N.E. Br.*, infrequent grass-like herb of moist and marshy grasslands, Summit Slopes and Plateau, *2656*

COMMELINACEAE
Commelina *L.*
africana *L.*
var. africana, trailing herb, infrequent in Summit Plateau grasslands, *2540*
var. krebsiana *(Kunth) C.B. Cl.*, herb, localized in sandy grasslands of Plateau Crest, *1285*
var. lancispatha *C.B. Cl.*, herb, infrequent in field layer of Woodland and Xeric Thicket of Low Country, *1724*
eckloniana *Kunth*, locally abundant herb of marshy grasslands, Plateau Crest, *1265*
livingstonii *C.B. Cl.*, occasional herb of mesic thickets, Mistbelt and Low Country, *720*
sp., widespread herb, includes *1188, 1406*
Aneilema *R. Br.*
aequinoctiale *(Beauv.) Kunth*, trailing herb in undergrowth of Tall (riparian) Forest, Low Country, *1837*
Cyanotis *D. Don*
lanata *Benth.*, small succulent herb, rare on sheet-rock formations in Low Country, *1894*
lapidosa *Phill.*, small herb, localized in rock crevices of Plateau Crest woodlands, *1409*
pachyrrhiza *Oberm.*, small succulent herb, localized in rock depressions of Plateau Crest woodlands, *1241*
speciosa *(L. f.) Hassk.*, occasional herb in grasslands of Humid Mistbelt, *1149A*
Floscopa *Lour.*
glomerata *(Willd. ex Schult. & Schult. f.) Hassk.*, localized herb in seepage areas of Tall Forest, Low Country, *1924*

JUNCACEAE
Juncus *L.*
lomatophyllus *Spreng.*, hydrophytic rosette herb of marshy grasslands, Summit Plateau, *2657*

LILIACEAE
Bulbine *Willd.*
sp., succulent geophyte, infrequent in lithoseral woodlands of Low Country
Trachyandra *Kunth*
reflexipilosa *(Kuntze) Oberm.*, widespread geophytic herb of Summit Plateau grasslands and shrublands, *2531*
saltii *(Bak.) Oberm.*, low perennial herb, localized in sandy grasslands of Escarpment Slopes and Plateau, *1090*
Anthericum *L.*
angulicaule *Bak.*, rare herb in sandy grasslands of Escarpment Crest, *1270*
cooperi *Bak.*, widespread geophytic herb in grasslands of Platcau Interior and Summit, *1364*
galpinii *Bak.* var. galpinii, localized herb, infrequent in lithoscral grasslands of Escarpment Plateau, *1280*
sp. cf. A. galpinii *Bak.*, infrequent herb of sheet-rock formations, Low Country, *1860*
Chlorophytum *Ker-Gawl.*
sp., infrequent herb in field layer of rocky woodlands, Plateau Crest, *1191A*
Eriospermum *Jacq. ex Willd.*
burchellii *Bak.*, geophytic herb localized in rocky shrublands of Transitional Mistbelt and in grasslands of Escarpment Slopes and Plateau, *1030*
cooperi *Bak.*, widespread geophytic herb, infrequent in Mistbelt grasslands and woodlands, *756*
luteo-rubrum *(Bak.)*, infrequent geophyte of retarded grassland, Summit Plateau, *2349*
sp. 1, infrequent grassland geophyte of Summit Plateau and Slopes, *2541*
sp. 2, infrequent geophytic herb in woodlands of Escarpment Slopes, includes *1858*
Kniphofia *Moench*
sp., perennial herb, infrequent in lithoseral grasslands of Escarpment Slopes, *1160*
splendida *E.A. Bruce*, perennial herb, localized in grasslands of Lower Mountain Slopes, *E.A. Bruce 315*
Aloe *L.*
arborescens *Mill.*, widespread shrubby species in rocky woodlands and forests, Mistbelt, *Scheepers 426*
barbertoniae *Pole Evans*, succulent perennial herb, widespread in Woodland and Xeric Thicket of Low Country, *1998*
longibracteata *Pole Evans*, succulent perennial herb, apparently confined to xeric thickets and woodlands, Mistbelt, *1992*
petricola *Pole Evans*, widespread succulent rosette herb, localized on sheet-rock formations, Low Country and in rocky woodlands, Humid Mistbelt, *1995*
sp., widespread succulent herb, includes *1993, 1994*
chortolirioides *Berger* var. woolliana *(Pole Evans) Glen & Hardy*, small succulent herb on steep rock ledges, Summit grasslands, *PNBG 29952*
Agapanthus *L'Hérit.*
inapertus *Beauv.* subsp. parviflorus *Leighton*, perennial herb often associated with riparian sites on Summit, *2627*
Tulbaghia *L.*
sp., infrequent perennial herb of rocky shrublands, Mistbelt, *2744*
Albuca *L.*
setosa *Jacq.*, low bulbous herb, infrequent in Plateau Interior grasslands, *1176*
Urginea *Steinh.*
capitata *(Hook.) Bak.*, occasional bulbous herb of rocky shrublands, Summit Plateau, *2457*
Dipcadi *Medik.*
marlothii *Engl.*, localized herb, infrequent in Escarpment Plateau grasslands, *1279*
Scilla *L.*
nervosa *(Burch.) Jessop*, bulbous rosette herb, localized in disturbed lithoseral grasslands of Escarpment and Summit Plateau, *1296*
Eucomis *L'Hérit.*
autumnalis *(Mill.) Chitt.* subsp. clavata *(Bak.) Reyneke*, fairly common bulbous herb of moist (often riparian), Summit grasslands, *2440*
Ornithogalum *L.*
saundersiae *Bak.*, geophyte in Low Country woodlands, *1752*
Ledebouria *Roth.*
cooperi *(Hook. f.) Jessop*, bulbous rosette herb, widespread in grasslands of Plateau Interior and Summit, *1369*
revoluta *(L. f.) Jessop*, bulbous geophyte, infrequent in Mistbelt grasslands, *1554*
sp., flattened succulent rosette herb, widespread in grasslands of Humid Mistbelt, includes *1212*
Dracaena *Vand. ex L.*
hookeriana *K. Koch*, subwoody shrub of shady field layer, widespread in Forest and Mesic Thicket of Mistbelt and Low Country, *907*
Protasparagus *Oberm.*
africanus *(Lam.) Oberm.*, small bush, widespread in woodlands and thickets, especially Low Country, *516*
falcatus *(L.) Oberm.*, robust spiny climber, common in forests and thickets of Mountain and Escarpment Slopes and Upper Foothills, *93*
laricinus *(Burch.) Oberm.*, localized shrubby species of rocky woodiand, Lower Mountain Slopes, *1567*
natalensis *(Bak.) Oberm.*, spiny climber, infrequent in Tall (riparian) Forest of Low Country, *1980F*
plumosus *(Bak.) Oberm.*, shrubby species in undergrowth of forests, Escarpment Slopes and Plateau, *1062*
racemosus *(Willd.) Oberm.*, infrequent undershrub of Low Country woodlands and thickets, *1706A*
rigidus *(Jessop) Oberm.*, small bush, localized in Plateau Crest woodlands, *1186*
setaceus *(Kunth) Oberm.*, small bush, common in forests of Mountain Slopes, *1385*
sp., common undershrub in forests, woodlands and thickets, especially Transitional Mistbelt and Low Country, includes *43*
Myrsiphyllum *Willd.*
asparagoides *(L.) Oberm.*, herbaceous twiner, rare in undergrowth of moist thickets, riparian woodlands, Summit and Lower Mountain Slopes, *2450*
ramosissimum *(Bak.) Oberm.*, small shrub of riparian forest, Mountain and Summit Slopes, *2136*
Behnia *Didr.*
reticulata *(Thunb.) Didr.*, perennial herbaceous twiner, common in forests and thickets of Mountain and Escarpment Slopes and Upper Foothills, *282*
Smilax *L.*
kraussiana *Meisn.*, common climber, widespread in forests, thickets and woodlands, Mistbelt and Low Country, *122*

AMARYLLIDACEAE
Haemanthus *L.*
carneus *Ker-Gawl.*, occasional herb of rocky woodlands, Lower Mountain Slopes, *1561*

sp., infrequent herb in grasslands of Lower Mountain Slopes, *1489*

Scadoxus *Raf.*

multiflorus *(Martyn) Raf.* subsp. multiflorus, occasional widespread herb of forests and thickets, *1728*

Boophane *Herb.*

disticha *(L. f.) Herb.*, bulbous herb, apparently localized in grasslands and woodlands of Escarpment Slopes

Clivia *Lindl.*

caulescens *R.A. Dyer*, perennial herb, localized in shady field layer of Mistbelt forests, *Scheepers 407*

Nerine *Herb.*

angustifolia *Bak.*, large bulbous herb of marshy grasslands, Summit Plateau, *2569*

Brunsvigia *Heist.*

radulosa *Herb.*, large bulbous herb, rare in grasslands of Lower Mountain Slopes

Crinum *L.*

sp., bulbous herb, occasional in lithoseral woodlands, Low Country, *974*

Cyrtanthus *L. f.*

bicolor *R.A. Dyer*, herb, infrequent in lithoseral grasslands of Escarpment Slopes, *1161*

HYPOXIDACEAE

Hypoxis *L.*

'complex', robust geophytic herb, widespread in grasslands and woodlands of Mistbelt and Low Country:

rigidula *Bak., 1302*

rooperi *S. Moore, 667*

costata *Bak.*, infrequent herb amongst rocks, Summit Peak shrublands, *2489*

filiformis *Bak.*, delicate geophytic herb, widespread in Mistbelt grasslands, *1093*

galpinii *Bak.*, widespread geophytic herb of rocky grasslands and woodlands, Mistbelt, *1112*

gerrardii *Bak.*, rare geophyte of Lower Mountain grasslands, *1502*

multiceps *Buchinger*, robust geophyte, localized in dolomite-soil grasslands of Plateau Interior, *1317*

VELLOZIACEAE

Xerophyta *Juss.*

retinervis *Bak.*, short woody perennial, common in early lithosere of Mistbelt and Low Country, *2003*

DIOSCOREACEAE

Dioscorea *L.*

'complex', soft perennial twiner, frequent in forests and thickets of Mistbelt and Low Country:

cotinifolia *Kunth, 655*

sylvatica *(Kunth) Eckl.* var. sylvatica, *377*

dregeana *(Kunth) Dur. & Schinz* var. dregeana, soft perennial twiner, infrequent in closed rocky woodlands of Escarpment Slopes, *1443A*

IRIDACEAE

Moraea *Mill.*

elliotii *Bak.*, small herb, localized in moist lithoseral grasslands of Escarpment Slopes, *1118*

muddii *N.E. Br.*, medium-size herb, occasional in Mistbelt grasslands, *1426*

sp., herb, scattered in woodlands and grasslands of Mistbelt, includes *1628B*

Dietes *Salisb. ex Klatt*

iridioides *(L.) Sweet ex Klatt*, gregarious herb, widespread but localized (sometimes dominant) in Forest and Mesic Thicket of Mistbelt and Low Country, *362*

Aristea *Ait.*

angolensis *Bak.*, infrequent herb of Summit Slope grasslands, *2310*

woodii *N.E. Br.*, widespread herb in woodlands and grasslands of Mistbelt and Low Country, *681*

Schizostylis *Backh. & Harv.*

coccinea *Backh. & Harv.*, localized herb of marshy grasslands and riparian woodlands, Summit Plateau, *2655*

Hesperantha *Ker-Gawl.*

baurii *Bak.*, apparently rare bulbous herb of rocky Protea woodland, Summit Slopes, *2599*

Dierama *K. Koch*

sp. cf. galpinii *N.E. Br.*, grass-like herb of Mistbelt grasslands, includes *1282A*

Crocosmia *Planch.*

aurea *Planch.*, geophytic herb in light shade of Short (riparian) Forest, Lower Mountain Slopes, *366*

paniculata *(Klatt) Goldbl.*, large geophytic herb of rocky shrublands, Mistbelt, *2743*

Gladiolus *L.*

densiflorus *Bak.*, large herb, scattered in grasslands and woodlands of Mistbelt and Low Country, *1708*

ecklonii *Lehm.*, subsp. ecklonii, widespread, infrequent herb in grasslands and woodlands of Mistbelt and Low Country, *1688*

exiguus *G.J. Lewis*, widespread herb in woodlands and grasslands, Mistbelt, *1482*

longicollis *Bak.* var. platypetalus *(Bak.) Oberm.*, widespread herb of Summit Plateau grasslands, *2350*

sp., widespread herb in grasslands and woodlands of Mistbelt and Low Country, includes *782, 1318*

varius *F. Bol.* var. micranthus *(Bak.) Oberm.*, widespread herb of Summit grasslands, *2740*

Watsonia *Mill.*

sp. cf. transvaalensis *Bak.*, perennial herb of rocky shrublands, Summit Slopes and Plateau, *2751*

STRELITZIACEAE

Strelitzia *Ait.*

caudata *R.A. Dyer*, herbaceous tree, infrequent in Tall Forest of Escarpment Slopes

ORCHIDACEAE

Stenoglottis *Lindl.*

fimbriata *Lindl.*, small orchid on rocks and bark of elfin-like forests, Plateau Crest, *1237*

Holothrix *L.C. Rich. ex Hook.*

scopularia *(Lindl.) Reichb. f.*, small ground orchid, apparently rare in Protea woodland, Summit Slopes, *2429*

Satyrium *Swartz*

cristatum *Sond.* var. longilabiatum *A.V. Hall*, infrequent geophytic herb of rocky shrublands, Mistbelt, *2746*

longicauda *Lindl.* var. longicauda, small geophytic herb, infrequent in grasslands of Summit Slopes, *2697*

Brownleea *Harv. ex Lindl.*

coerulea *Harv. ex Lindl.*, small herb, infrequent in closed woodlands of Low Country, *830*

Disa *Berg.*

stachyoides *Reichb. f.*, infrequent ground orchid of encroached grasslands, Summit Plateau, *2550*

Disperis *Swartz*

fanniniae *Harv.*, small herb on rocks of elfin-like forests, Plateau Crest, *1239*

Polystachya *Hook.*

concreta *(Jacq.) Garay & Sweet*, epiphytic orchid, occasional in mesic thickets of Transitional Mistbelt, *1622*

ottoniana *Reichb. f.*, small epiphytic orchid with rows of pseudobulbs forming mats on trees in elfin-like forests, Plateau Crest, *1201*

sp., epiphytic orchid localized in mesic thickets, Transitional Mistbelt, includes *926, 1049*

Ansellia *Lindl.*

gigantea *Reichb. f.*, large-tufted epiphytic orchid, apparently localized in xeric thickets of Low Country, *803*

Eulophia *R. Br. ex Lindl.*

horsfallii *(Batem.) Summerh.*, large ground orchid in Low Country riparian forests

streptopetala *Lindl.*, large ground orchid in light shade of forests, woodlands and thickets, Mistbelt and Low Country, *1446*

Bulbophyllum *Thouars*

sandersonii *Reichb. f.*, orchid on rocks and bark of elfin-like forests, Plateau Crest, *1198*

Tridactyle *Schltr.*

tricuspis *(H. Bol.) Schltr.*, widespread epiphyte in Forest and Mesic Thicket of Mistbelt and Low Country, *658A*

ANGIOSPERMAE — DICOTYLEDONAE

PIPERACEAE

Piper *L.*

capense *L. f.*, soft shrub, sometimes dominant in Tall Forest of Escarpment and Mountain Slopes, *2055*

Peperomia *Ruiz. & Pav.*
blanda *(Jacq.) H.B.K.* var. leptostachya *(Hook. & Arn.) Duell*, small occasional herb on rocks in mesic thickets, Transitional Mistbelt, *708*
retusa *(L. f.) A. Dietr.*, small epiphytic herb (also on rocks) common in forests and mesic thickets, Mistbelt, *715*
tetraphylla *(G. Forst.) Hook. & Arn.*, small epiphytic herb (also on rocks) localized in forests of Humid Mistbelt, *1192*

MYRICACEAE
Myrica *L.*
pilulifera *Rendle*, small tree, widespread in rocky woodlands of Mistbelt, *960*
serrata *Lam.*, small tree of river banks, Low Country, *897*

ULMACEAE
Celtis *L.*
africana *Burm. f.*, tall tree, widespread in forests, woodlands and thickets of Mistbelt and Low Country, *256*
Trema *Lour.*
orientalis *(L.) Blume*, medium-size pioneer tree, widespread in thickets and woodlands of Mistbelt and Low Country, *794*

MORACEAE
Ficus *L.*
ingens *(Miq.) Miq.* var. ingens, fairly small tree, localized on rocks of Mistbelt and Low Country, *811*
sur *Forssk.*, fairly large tree, widespread in forests, woodlands and thickets of Mistbelt and Low Country, *858*
thonningii *Blume*, medium-size tree, widespread in forests, woodlands and thickets of Mistbelt and Low Country, *872*

URTICACEAE
Laportea *Gaudich.*
peduncularis *(Wedd.) Chew*, shrubby perennial, infrequent in rocky forested kloofs of Lower Foothills, *1756*

PROTEACEAE
Faurea *Harv.*
galpinii *Phill.*, rare understorey tree of Tall Forest, Upper Mountain Slopes
saligna *Harv.*, medium-size tree, often dominant in woodlands of Low Country, *1788*
speciosa *(Welw.) Welw.*, small tree, common in woodlands and thickets of Mistbelt and Low Country, *644*
Protea *L.*
caffra *Meisn.*, small tree of rocky grasslands and woodlands, Mistbelt, *1488*
gaguedi *Gmel.*, small tree, occasional in rocky grasslands of Summit and Escarpment Slopes, *1145A*
parvula *Beard*, low prostrate shrublet, widespread in Summit grasslands and shrublands, *2330*
roupelliae *Meisn.* subsp. roupelliae, small tree of rocky woodlands, Summit Slopes, *2594*
welwitschii *Engl.*, small tree, common in localized open woodlands of Plateau Interior, *1666*

LORANTHACEAE
Tapinanthus *(Blume) Reichb.*
rubromarginatus *(Engl.) Danser*, woody epiphytic parasite in Protea woodland, Summit Slopes, *2610*
Erianthemum *V. Tieghem*
dregei *(Eckl. & Zeyh.) V. Tieghem*, woody hemiparisitic epiphytic bush, fairly localized in rocky xeric thickets of Low Country, *846*

SANTALACEAE
Osyridicarpos *A. DC.*
schimperianus *(Hochst. ex A. Rich.) A. DC.*, shrubby hemiparasitic climber, localized in thickets of Transitional Mistbelt, *701*
Thesium *L.*
costatum *A.W. Hill*, small perennial forb (hemiparasitic), infrequent in Mistbelt shrublands and grasslands, *1216*
cytisoides *A.W. Hill*, infrequent forb in marshy grasslands, Plateau Crest, *1268*
goetzeanum *Engl.*, small perennial forb, infrequent in retarded grasslands, Summit Plateau, *2321*
sp., infrequent forb in Mistbelt grasslands, includes *1500, 2557*

OLACACEAE
Ximenia *L.*
caffra *Sond.*, small tree, occasional in Low Country woodlands, *1772*

POLYGONACEAE
Rumex *L.*
bequaertii *De Wild.*, occasional herb of marshy grasslands, Summit Plateau, *2574*
sagittatus *Thunb.*, shrubby perennial climber, localized in rocky woodlands and thickets of Plateau Crest, *1411*
sp., occasional waterside herb of riparian woodlands, Summit Plateau, *2441*
Polygonum *L.*
salicifolium *Willd.*, small infrequent herb of stream banks, Lower Foothills, *1911*
Oxygonum *Burch.*
dregeanum *Meisn.* var. strictum *(C.H. Wr.) R.A. Grah.*, rare semi-succulent bushy herb of Summit Plateau grasslands, *2553*

AMARANTHACEAE
Cyathula *Blume*
cylindrica *Moq.*, infrequent shrubby scrambler of Tall Forest, especially Low Country, *1410*
Pupalia *Juss.*
atropurpurea *Moq.*, shrubby climber, infrequent in Low Country forests, *1757*
*Achyranthes *L.*
sicula *(L.) All.*, infrequent forb, widespread throughout Mistbelt and Low Country, *1599*

PHYTOLACCACEAE
Phytolacca *L.*
octandra *L.*, infrequent shrub in Tall Forest of Escarpment Slopes, *1066*.

AIZOACEAE
Psammotropha *Eckl. & Zeyh.*
myriantha *Sond.*, low tufted herb, localized in Summit Peak grasslands, *2734*

RANUNCULACEAE
Knowltonia *Salisb.*
transvaalensis *Szyszyl.* var. transvaalensis, rosette forb, widespread in grasslands of Escarpment Slopes and Plateau, *744*
Clematis *L.*
brachiata *Thunb.*, infrequent liane, widespread in Forest and Mesic Thicket of Mistbelt and Low Country, *1383*
Ranunculus *L.*
multifidus *Forssk.*, small infrequent herb of riparian woodlands, Summit Plateau, *2436*
Thalictrum *L.*
rhynchocarpum *Dill. & Rich.*, robust perennial herb of cool moist shady undergrowth, Mountain Slopes forests, *1353A*

MENISPERMACEAE
Cocculus *DC.*
hirsutus *(L.) Diels*, slender twiner, infrequent in sheltered thickets of Lower Foothills, *2027*
Stephania *Lour.*
abyssinica *Dill. & Rich.*, slender climber, infrequent in riparian woodlands and forests of Mistbelt, *216*
Cissampelos *L.*
torulosa *E. Mey. ex Harv.*, soft twiner, abundant in forests and thickets of Mistbelt and Low Country, *200*

ANNONACEAE
Monanthotaxis *Baill.*
caffra *(Sond.) Verdc.*, scrambling shrub, common in Forest and Mesic Thicket of Mistbelt and Low Country, especially below Escarpment Plateau, *707*
Annona *L.*
senegalensis *Pers.*, low spreading tree, localized and widespread in Woodland and Xeric Thicket of Low Country, *738*

TRIMENIACEAE
Xymalos *Baill.*
monospora *(Harv.) Baill.*, medium-size tree, often dominating the understorey of forests in Humid Mistbelt, *1002*

LAURACEAE
Cryptocarya *R. Br.*
liebertiana *Engl.*, dominant canopy tree of Tall Forest, Mountain Slopes, *2244*
Ocotea *Aubl.*
kenyensis *(Chiov.) Robyns*, large tree, infrequent in forests of Mistbelt and Low Country, *1388*

BRASSICACEAE
Rorippa *Scop.*
*nasturtium-aquaticum *(L.) Hayek*, infrequent herb in shelter of large boulders, Summit Peak shrublands, *2494*

CAPPARACEAE
Capparis *L.*
brassii *DC.*, fairly rare scrambling shrub of Tall (riparian) Forest, Low Country, *896*
sepiaria *L.* var. subglabra *(Oliv.) De Wolf*, rare scrambler in Tall (riparian) Forest, Lower Foothills, *1874*

DROSERACEAE
Drosera *L.*
burkeana *Planch.*, fairly common insectivorous herb of Summit grasslands, *2533*
sp., small insectivorous herb, infrequent in sandy grasslands of Plateau Crest

CRASSULACEAE
Kalanchoe *Adans.*
rotundifolia *(Haw.) Haw.*, widespread succulent herb of Mistbelt and Low Country lithosere, *779*
Crassula *L.*
acinaciformis *Schinz*, giant subsucculent herb, infrequent in woodlands and thickets of Low Country
alba *Forssk.*
'complex', succulent herb, common in lithoseral grasslands and woodlands, especially Mistbelt:
var. alba, *1416A*
var. parvisepala *(Schonl.) Toelken, R71*
natalensis *Schonl.*, small succulent herb of rock depressions, Mistbelt woodlands, *1521*
pellucida *L.* subsp. brachypetala *(Drège ex Harv.) Toelken*, small infrequent herb, gregarious in moist field layer of forests, Escarpment Slopes, *1125*
sarcocaulis *Eckl. & Zeyh.* subsp. sarcocaulis, succulent shrublet, widespread in Mistbelt rock formations, *1228*
sp., occasional herb of moist grasslands, Escarpment Slopes, includes *1115*
swaziensis *Schonl.*, small herb of rock formations in woodlands and forests, Plateau Crest, *1232*
vaginata *Eckl. & Zeyh.*, succulent herb, infrequent in Mistbelt grasslands, *1483*

ESCALLONIACEAE
Choristylis *Harv.*
rhamnoides *Harv.*, shrub of Mistbelt thickets and forests, *831*

PITTOSPORACEAE
Pittosporum *Banks ex Soland.*
viridiflorum *Sims*, small tree, mainly localized in understorey of thickets and woodlands, Transitional Mistbelt, *1793*

MYROTHAMNACEAE
Myrothamnus *Welw.*
flabellifolia *(Sond.) Welw.*, xerophytic shrublet of sheet-rock formations, especially Low Country, *1853*

HAMAMELIDACEAE
Trichocladus *Pers.*
grandiflorus *Oliv.*, large tree in canopy of Tall Forest, Plateau Crest and Escarpment Upper Slopes, *1059*

ROSACEAE
Rubus *L.*
pinnatus *Willd.*, widespread scrambler in forests and woodlands of Mistbelt and Low Country, *2023*
sp., widespread scrambler in Forest and Mesic Thicket of Mistbelt and Low Country, includes *480*
Alchemilla *L.*
rehmannii *Engl.*, infrequent herb of stream banks, Summit Plateau, *2438*
Agrimonia *L.*
*odorata *Mill.*, subwoody herb, infrequent in moist low thickets of Mountain Slopes, *1596*
Leucosidea *Eckl. & Zeyh.*
sericea *Eckl. & Zeyh.*, small (usually riparian) tree of Summit and Mountain Slopes, *56*
Cliffortia *L.*
nitidula *(Engl.) R.E. & Th. Fries Jr* subsp. pilosa *Weim.*, common ericoid shrub of open rocky woodlands and forest margins, Mistbelt, *1693*
repens *Schltr.*, ericoid shrub, infrequent in Mistbelt grasslands, *1082*
serpyllifolia *Cham. & Schlechtd.*, infrequent shrub amongst rocks. Summit Peak shrublands, *2502*
Prunus *L.*
africana *(Hook. f.) Kalkm.*, large canopy tree, occasional (sometimes dominant) in Mistbelt forests, *966*

CHRYSOBALANACEAE
Parinari *Aubl.*
capensis *Harv.* subsp. capensis, low shrublet often associated with rock outcrops, widespread in grasslands of Escarpment Plateau, *1295*
curatellifolia *Planch. ex Benth.*, fairly large canopy tree, abundant (often dominant) in thickets and woodlands of Mistbelt and Low Country, *7*

CONNARACEAE
Cnestis *Juss.*
natalensis *(Hochst.) Planch. & Sond.*, small understorey tree in Mistbelt forests and mesic thickets, *908*

FABACEAE
Albizia *Durazz.*
versicolor *Welw. ex Oliv.*, medium-size tree, infrequent in woodlands of Upper Foothills, *2039*
Acacia *Mill.*
ataxacantha *DC.*, abundant and vigorous scandent tree, dominant in thickets of Mistbelt and Low Country, *650*
caffra *(Thunb.) Willd.*, small tree, widespread in Woodland and Xeric Thicket of Low Country, *818*
davyi *N.E. Br.*, small tree, widespread in Woodland and Xeric Thicket of Low Country, *767*
*mearnsii *De Wild.*, naturalized exotic tree, fairly widespread
sp., small tree scattered infrequently in woodlands and thickets of Mistbelt and Low Country, includes *868*
Dichrostachys *(A. DC.) Wight & Arn.*
cinerea *(L.) Wight & Arn.*
'complex', small tree, localized and widespread in Woodland and Xeric Thicket of Low Country:
subsp. africana *Brenan & Brumm.* var. africana, *628*
subsp. nyassana *(Taub.) Brenan, 723*
Entada *Adans.*
spicata *(E. Mey.) Druce*, robust prickly liane, localized in Tall Forest of Mistbelt and Low Country, *1008*
Bauhinia *L.*
galpinii *N.E. Br.*, abundant scrambling shrub, often dominant in woodlands, thickets and forests, especially Low Country, *2030*
Piliostigma *Hochst.*
thonningii *(Schumach.) Milne-Redh.*, infrequent small tree in Low Country woodlands, *471*
Tylosema *(Schweinf.) Torre & Hillc.*
fassoglensis *(Schweinf.) Torre & Hillc.*, widespread robust creeper, a persistent pioneer of lithoseral woodlands and thickets; exclusively Low Country, *519*
Cassia *L.*
*bicapsularis *L.*, shrubby climber, infrequent in mesic thickets of Upper Foothills, *1800*
*floribunda *Cav.*, occasional shrub in mesic thickets of Low Country, *257*
mimosoides *L.*, small subwoody forb, infrequent in sandy grasslands of Plateau Crest, *1643*
petersiana *Bolle*, widespread shrub in Woodland and Xeric Thicket of Low Country, *738*
plumosa *(E. Mey.) Vogel* var. erecta *Schorn & Gordon-Gray*, small subwoody forb, infrequent in rocky grasslands of Lower Mountain Slopes, *1552*
quarrei *(Ghesq.) Steyaert*, subwoody forb, localized in disturbed open woodlands of Upper Foothills, *599*
Peltophorum *(Vogel) Benth.*

africanum *Sond.*, medium-size tree, widespread in thickets and woodlands of Foothills, *803A*
Calpurnia *E. Mey.*
aurea *(Ait.) Benth.*, small localized tree in understorey of forests, Lower Mountain Slopes, *295*
Lotononis *(DC.) Eckl. & Zeyh.*
pulchra *Duemmer*, infrequent shrublet in grasslands of Lower Mountain Slopes, *1476*
Pearsonia *Duemmer*
aristata *(Schinz) Duemmer*, subwoody shrublet, widespread but infrequent in grasslands and woodlands of Mistbelt and Low Country, *1518A*
obovata *(Schinz) Polhill*, prostrate subwoody forb, infrequent in Mistbelt grasslands, *1522*
sessilifolia *(Harv.) Duemmer*
'complex', subwoody bushy forb, widespread and common in woodlands and grasslands of Mistbelt and Low Country:
subsp. marginata *(Schinz) Polhill, 1452*
subsp. sessilifolia, *1707*
uniflora *(Kensit) Polhill*, subwoody forb, rare in xeric thickets of Low Country, *821*
Crotalaria *L.*
capensis *Jacq.*, small shrub in Tall (riparian) Forest, Low Country, *888*
recta *Steud. ex A. Rich.*, small shrub, localized in disturbed woodlands and thickets of Upper Foothills, *1624*
Argyrolobium *Eckl. & Zeyh.*
harveyanum *Oliv.*, slender perennial herb, infrequent in grasslands of Summit Slopes, *2373*
speciosum *Eckl. & Zeyh.*, infrequent subwoody forb scattered in woodlands, grasslands and thickets of Mistbelt and Low Country, *709*
transvaalense *Schinz*, infrequent subwoody forb in xeric thickets, Low Country, *1840*
Lotus *L.*
discolor *E. Mey.* subsp. discolor, fairly rare shrublet in moist grasslands of Escarpment Lower Slopes, *1946*
Indigofera *L.*
comosa *N.E. Br.*, infrequent shrublet of sheet-rock formations, Low Country, *1883*
hedyantha *Eckl. & Zeyh.*, infrequent subwoody forb of retarded grasslands, Summit Plateau, *2356*
hilaris *Eckl. & Zeyh.*, subwoody forb, infrequent in grasslands of Mountain Slopes, *1535*
oxalidea *Welw. ex Bak.*, prostrate forb, infrequent in grasslands and woodlands of Mistbelt and Low Country, *731*
sanguinea *N.E. Br.*, subwoody forb, fairly frequent in grasslands of Summit and Escarpment Plateau, *2073*
sp., shrublet or prostrate forb of moist grasslands, Escarpment Lower Slopes, includes *1945*
sp. 1, subwoody shrublet localized in grasslands of Lower Mountain Slopes, *1460*
sp. 2, shrublet localized in grasslands of Mountain Slopes, *1475*
swaziensis *H. Bol.*, small shrub, widespread and common in woodlands, grasslands and xeric thickets of Mistbelt and Low Country, *665*
tristoides *N.E. Br.*, small shrub, infrequent in grasslands and disturbed (sometimes riparian) woodlands of Mistbelt, *1939*
Otholobium *C.H. Stirton*
polystictum *(Benth. ex Harv.) C.H. Stirton*, infrequent shrub of wooded rocky knolls, Summit, *2311*
Tephrosia *Pers.*
'complex', large forb, mainly in Low Country thickets and woodlands:
polystachya *E. Mey.* var. latifolia *Harv., 765A*
shiluwanensis *Schinz, 765*
elongata *E. Mey.* var. elongata, lax forb, infrequent in grasslands, woodlands and thickets of Mistbelt and Low Country, *1153*
macropoda *(E. Mey.) Harv.*, lax forb, infrequent in grasslands of Escarpment Slopes, *1117*
semiglabra *Sond.*, forb, infrequent in rocky shrublands of Lower Mountain Slopes, *1553*
Aeschynomene *L.*
nyassana *Taub.*, subwoody forb, common in rocky woodlands and grasslands of Humid Mistbelt, *1182*
rehmannii *Schinz*, subwoody forb, infrequent and localized in sandy grasslands of Plateau Crest, *1246*
var. leptobotrya *(Harms ex Bak. f.) J.B. Gillett*, subwoody forb, localized in rocky grasslands, shrublands and woodlands of Escarpment Upper Slopes, Plateau Crest and Summit, *1420*
Smithia *Ait.*
erubescens *(E. Mey.) Bak. f.*, shrublet in grasslands of Transitional Mistbelt, *1950*
Stylosanthes *Swartz*
fruticosa *(Retz.) Alston*, infrequent subwoody forb of disturbed woodlands, Upper Foothills, *604*
Zornia *J.F. Gmel.*
milneana *Mohlenbr.*, rare ground creeper of disturbed grasslands, Plateau Crest, *1298*
Desmodium *Desv.*
dregeanum *Benth.*, small shrub, infrequent in disturbed grasslands of Upper Foothills, *737*
gangeticum *(L.) DC.*, infrequent lax forb of woodlands and thickets, Low Country, *793*
repandum *(Vahl) DC.*, small undershrub, widespread and common in Forest and Mesic Thicket of Mistbelt and Low Country, *1002A*
setigerum *(E. Mey.) Benth. ex Harv.*, ground creeper, infrequent in disturbed grasslands and woodlands of Mistbelt, *1288*
Pseudarthria *Wight & Arn.*
hookeri *Wight & Arn.* var. hookeri, robust shrubby forb, widespread and common in Woodland and Xeric Thicket of Low Country and in Mistbelt grasslands and woodlands, *610*
Dalbergia *L. f.*
armata *E. Mey.*, robust spiny liane, common and widespread in forests and mesic thickets, especially below Escarpment Plateau, *21*
Pterocarpus *Jacq.*
angolensis *DC.*, fairly large canopy tree, mainly confined to Woodland and Xeric Thicket of Low Country, *248*
rotundifolius *(Sond.) Druce* subsp. rotundifolius, fairly large canopy tree, confined to partially sheltered woodlands and thickets on shallow soils of Lower Foothills, *2040*
Abrus *Adans.*
laevigatus *E. Mey.*, slender subwoody twiner, common in forests, thickets and woodlands below Escarpment Plateau, *713*
Dumasia *DC.*
villosa *DC.* var. villosa, soft twiner in shrub layer of Tall Forest, Mountain Slopes, *1573*
Neonotonia *Lackey*
wightii *(Arn.) Lackey*, localized climber of xeric thickets, Low Country, *802*
Erythrina *L.*
latissima *E. Mey.*, small tree, infrequent in woodlands of Plateau Crest and Escarpment Slopes, *1437*
lysistemon *Hutch.*, fairly large tree, widespread in forests, thickets and woodlands of Mistbelt and Low Country, *874*
Mucuna *Adans.*
coriacea *Bak.* subsp. irritans *(Burtt Davy) Verdc.*, soft perennial twiner, fairly common in woodlands and thickets of Foothills, *1626*
Rhynchosia *Lour.*
angulosa *Schinz*, localized forb in grasslands of Lower Mountain Slopes, *1485*
caribaea *(Jacq.) DC.*, slender twiner, widespread in forests, thickets and woodlands of Mistbelt and Low Country, *696*
hirta *(Andr.) Meikle & Verdc.*, subwoody soft twiner, localized in forests and mesic thickets of Foothils, *42*
komatiensis *Harms*, small shrub, widespread and common but localized mainly in Woodland and Xeric Thicket of Low Country, *620*
monophylla *Schltr.*, herbaceous creeper, common in broken lithoseral grasslands and woodlands of Mistbelt, *1413A*
sordida *(E. Mey.) Schinz*, large subwoody forb, infrequent and localized in disturbed woodlands of Upper Foothills, *1829*
thorncroftii *(Bak. f.) Burtt Davy*, infrequent small shrub of riparian forests, Escarpment Lower Slopes, *988*
totta *(Thunb.) DC.*, small delicate twiner, occasional in grasslands and woodlands of Mistbelt and Low Country, *1327*
villosa *(Meisn.) Druce*, large forb, infrequent in moist grasslands of Summit and Plateau Crest, *1261*
woodii *Schinz*, occasional prostrate subshrub of Summit grasslands, shrublands and woodlands, *2519*

Eriosema *(DC.) G. Don*
angustifolium *Burtt Davy*, widespread forb of Humid Mistbelt grasslands, *1244*
burkei *Benth.*, infrequent forb of dolomite-soil grasslands, Plateau Interior, *1345*
cordatum *E. Mey.*, infrequent forb of Mistbelt grasslands, *1362*
ellipticifolium *Schinz*, widespread forb of Mistbelt grasslands, *1116*
gunniae *C.H. Stirton*, occasional forb of Mistbelt grasslands, *1544*
kraussianum *Meisn.*, common forb of retarded grasslands, Summit Plateau and Slopes, *2345*
nutans *Schinz*, localized forb of Plateau Interior grasslands, *1657*
psoraleoides *(Lam.) G.Don*, robust shrubby forb, infrequent in Low Country woodlands, *1768*
Flemingia *Roxb. ex Ait. f.*
grahamiana *Wight & Arn.*, robust shrubby forb, infrequent in Low Country woodlands, *2034*
Vigna *Savi*
oblongifolia *A. Rich.* var. oblongifolia, soft slender twiner, rare in sheltered woodlands of Lower Foothills, *1780*
nervosa *Markoetter*, delicate twiner, infrequent in grasslands of Humid Mistbelt, *1481*
Sphenostylis *E. Mey.*
angustifolia *Sond.*, lax herbaceous twiner, infrequent and localized in Escarpment Plateau grasslands, *1334*
marginata *E. Mey.* subsp. marginata, vigorous climber, infrequent in thickets of Upper Foothills, *692*

GERANIACEAE
Geranium *L.*
ornithopodon *Eckl. & Zeyh.*, trailing herb, common in moist (often riparian) grasslands and woodlands, Summit, *2433*
Monsonia *L.*
attenuata *Harv.*, rare forb of moist grasslands, Escarpment Lower Slopes, *1688*
transvaalensis *Knuth*, widespread forb of Summit grasslands, *2552*

OXALIDACEAE
Oxalis *L.*
depressa *Eckl. & Zeyh.*, very small delicate herb, infrequent in Mistbelt grasslands and open woodlands, *1507*
obliquifolia *Steud. ex Rich.*, small herb, widespread in Summit grasslands, woodlands and shrublands, *2516*

LINACEAE
Linum *L.*
thunbergii *Eckl. & Zeyh.*, small localized herb of disturbed lithoseral grasslands, Plateau Crest, *1284*

RUTACEAE
Zanthoxylum *L.*
capense *(Thunb.) Harv.*, small tree, localized in shrub layer of forests, especially Escarpment Slopes, *334*
davyi *(Verdoorn) Waterm.*, widespread canopy tree of woodlands, forests and thickets of Mistbelt and Low Country, *694*
thorncroftii *(Verdoorn) Waterm.*, small tree, localized in shrub layer of elfin-like forests, Plateau Crest
Vepris *Comm. ex A. Juss.*
undulata *(Thunb.) Verdoorn & C.A. Sm.*, infrequent understorey tree of High Forest, Upper Mountain Slopes, *2254*
Toddalia *Juss.*
asiatica *(L.) Lam.*, robust prickly liane, commonly localized in forests and mesic thickets below Escarpment Plateau, *2025*
Clausena *Burm. f.*
anisata *(Willd.) Hook. f. ex Benth.*, small understorey tree, widespread in forests of Mistbelt and Low Country, *875*
Citrus *L.*
*spp., exotic tree of cultivation, occasionally encroaching on mesic thickets of Transitional Mistbelt

SIMAROUBACEAE
Kirkia *Oliv.*
acuminata *Oliv.*, medium size deciduous tree, infrequent in moist woodlands and forests of Low Country, *1718*

PTAEROXYLACEAE
Ptaeroxylon *Eckl. & Zeyh.*
obliquum *(Thunb.) Radlk.*, infrequent understorey tree of High Forest, Mountain Slopes, *2246*

MELIACEAE
Ekebergia *Sparrm.*
capensis *Sparrm.*, small tree, localized and rare in understorey of Tall (riparian) Forest, Low Country, *892*
pterophylla *(C. DC.) Hofmeyr*, small tree, localized in elfin-like forests and rocky woodlands of Plateau Crest, *1689*
Trichilia *P. Br.*
emetica *Vahl*, fairly large canopy tree, infrequent in Low Country forests, *1753*

MALPHIGIACEAE
Sphedamnocarpus *Planch. ex Benth. & Hook. f.*
galphimiifolius *(Juss.) Szyszyl.*
subsp. galphimiifolius, slender subwoody climber, infrequent in forests of Escarpment Lower Slopes, *1959*
subsp. rehmannii *Launert*, robust climber, infrequent in xeric thickets of Low Country, *819*
pruriens *(Juss.) Szyszyl.*
var. lanceolatus *Launert*, subwoody climber, infrequent in developing thickets of Escarpment Upper Slopes, *1674*
var. pruriens, infrequent subwoody climber of xeric thickets, Low Country, *500*

POLYGALACEAE
Polygala *L.*
hottentotta *Presl*, small infrequent herb, widespread in woodlands and grasslands of Mistbelt and Low Country, *625*
sp., occasional forb of Summit shrublands and woodlands, includes *2640, 2648*
uncinata *E. Mey. ex Meisn.*, small infrequent herb, mainly localized on sheet-rock formations supporting woodland, Low Country, *978*
virgata *Thunb.*, small infrequent shrub of Upper Foothill thickets, *943*
Muraltia *Juss.*
flanaganii *H. Bol.*, infrequent ericoid shrublet of rocky shrublands, Summit Peak, *2507*
sp., prostrate ericoid shrublet, infrequent in low shrublands of exposed Summit Slopes, *2410*

EUPHORBIACEAE
Andrachne *L.*
ovalis *(Sond.) Müll. Arg.*, infrequent shrub in riparian forests, Upper Foothills, *1044*
Securinega *Comm. ex Juss.*
virosa *(Roxb. ex Willd.) Pax & K. Hoffm.*, localized shrub in woodlands and thickets, Low Country, *792*
Phyllanthus *L.*
nummulariifolius *Poir.*, infrequent shrub of xeric woodlands, Lower Foothills, *1774*
reticulatus *Poir.*, untidy localized shrub of Low Country woodlands, especially on broken lithosere, *1698*
Drypetes *Vahl*
gerrardii *Hutch.*, small understorey tree, localized in riparian forests of Mountain Slopes, *900*
Antidesma *L.*
venosum *E. Mey. ex. Tul.*, low spreading tree, common and widespread in thickets and woodlands, especially Low Country, *637*
Bridelia *Willd.*
micrantha *(Hochst.) Baill.*, fairly large tree, common in thickets and woodlands. Often a pioneer on sheet-rock formations, mainly Low Country, *652*
Adenocline *Turcz.*
acuta *(Thunb.) Baill.*, soft undershrub, infrequent in kloof forests of Upper Mountain Slopes, *2151*
Acalypha *L.*
angustata *Sond.* var. glabra *Sond.*, localized subwoody forb of Lower Mountain Slope grasslands, *1458*
caperonioides *Baill.*, widespread subwoody forb of Lower Mountain and Summit Plateau moist grasslands, *1534*
petiolaris *Hochst.*, localized subwoody forb of Foothill woodlands, *758*
punctata *Meisn.*, infrequent subwoody forb of Upper Foothill woodlands and thickets, *622*
wilmsii *Pax ex Prain & Hutch.*, subwoody forb, common in woodlands and grasslands of Humid Mistbelt, *1422*

Tragia *L.*
okanyua *Pax*, slender twiner, infrequent in disturbed xeroclinal woodlands of Upper Foothills, *672*
rupestris *Sond.*, slender twiner or creeper occurring in Plateau Interior grasslands and Foothill thickets, *799*
sp., infrequent twiner of Low Country woodlands, includes *1820*

Ctenomeria *Harv.*
capensis *(Thunb.) Harv. ex Sond.*, large twiner, infrequent in mesic thickets of Escarpment Lower Slopes, *1401*

Dalechampia *L.*
capensis *Spreng. f.*, slender climber, localized in rocky mesic thickets of Upper Foothills, *712A*

Clutia *L.*
abyssinica *Jaub. & Spach* var. abyssinica, prostrate subwoody herb, infrequent in disturbed woodlands of Upper Foothills, *752*
affinis *Sond.*, soft shrub of Cyathea riparian woodland, Summit Plateau, *2120*
hirsuta *E. Mey. ex Sond.*, small shrub, infrequent in xeroclinal thickets of Upper Foothills, *940*
monticola *S. Moore*, frequent subwoody herb of woodlands and grasslands, especially Humid Mistbelt, *869*

Euphorbia *L.*
epicyparissias *E. Mey. ex Boiss.*, undershrub in Leucosidea riparian woodland, Summit Plateau, *2112*
ingens *E. Mey. ex Boiss.*, large succulent tree, usually associated with rocky xeric thickets and woodlands, Low Country
kraussiana *Bernh.*, small herbaceous perennial, rare in undergrowth of rocky riparian thickets, Escarpment Lower Slopes, *932*
striata *Thunb.*, localized forb of Plateau Crest grasslands, *1202*

ANACARDIACEAE

Sclerocarya *Hochst.*
birrea *(A.Rich.) Hochst.* subsp. caffra *(Sond.) Kokwaro*, large tree, widely scattered in Low Country woodlands, *1844*

Lannea *A. Rich.*
discolor *(Sond.) Engl.*, small tree of lithoseral woodlands and thickets, Low Country, *814*
edulis *(Sond.) Engl.*, low woody forb, widespread in Woodland and Xeric Thicket of Low Country and in lithoseral grasslands of Plateau Crest, *1421*

Protorhus *Engl.*
longifolia *(Bernh.) Engl.*, medium-size tree, common in forests of Plateau Crest and Escarpment Lower Slopes and in lithoseral woodlands and thickets, especially Upper Foothills, *914*

Rhus *L.*
chirindensis *Bak. f.*, occasional tree in understorey or canopy of Escarpment Slopes forests, *939*
dentata *Thunb.*, widespread small tree occurring throughout Mistbelt and Low Country, *675*
discolor *E. Mey. ex Sond.*, small shrub in grasslands of Mountain Slopes, precursor to open woodland, *1529*
pentheri *Zahlbr.*, small understorey tree of forests, woodlands and thickets of Low Country, *757*
pyroides *Burch.* var. pyroides, small bushy tree, widespread in forests, woodlands and thickets of Mistbelt and Low Country, *760*
rehmanniana *Engl.*, small tree, mainly localized in Plateau Crest woodlands, *1436*
transvaalensis *Engl.*, small tree, common and widespread in woodlands and thickets, especially Woodland and Xeric Thicket of Low Country, *675A*
tumulicola *S. Moore*, localized shrub of broken lithoseral shrublands and woodlands, especially Summit and Plateau Crest, *1185*

AQUIFOLIACEAE

Ilex *L.*
mitis *(L.) Radlk.*, infrequent waterside tree, Mistbelt forests, *1354*

CELASTRACEAE

Maytenus *Molina*
acuminata *(L. f.) Loes.* var. acuminata, frequent understorey and canopy tree of Mountain Slopes forests, *2109*
heterophylla *(Eckl. & Zeyh.) N.K.B. Robson*, small tree, common in woodlands and thickets, especially Low Country, *601*
mossambicensis *(Klotzsch) Blakelock* var. mossambicensis, small tree, frequent in Forest and Mesic Thicket of Mistbelt and Low Country, *269*
peduncularis *(Sond.) Loes*, small tree, scattered infrequently in Forest and Mesic Thicket of Mistbelt and Low Country, *900*
undata *(Thunb.) Blakelock*, small tree of forests, woodlands and thickets, especially Low Country, *837*

Catha *Forssk. ex Scop.*
edulis *(Vahl) Forssk. ex Endl.*, medium-size tree localized in Low Country thickets, often on rocky sites, *644A*

Pterocelastrus *Meisn.*
echinatus *N.E. Br.*, occasional small tree in humid Mistbelt forests and woodlands, *1067*

Cassine *L.*
euclciformis *(Eckl. & Zeyh.) Kuntze*, infrequent small tree of Tall Forest, Mountain Slopes, *2284*
papillosa *(Hochst.) Kuntze*, understorey tree of Tall Forest, Mountain Slopes, *2279*
tetragona *(L. f.) Loes.*, infrequent understorey tree in High Forest, Upper Mountain Slopes, *2169*

Hippocratea *L.*
crenata *(Klotzsch) K. Schum. & Loes.*, infrequent scandent shrub of High Forest, Mountain Slopes, *2243*

ICACINACEAE

Cassinopsis *Sond.*
ilicifolia *(Hochst.) Kuntze*, small understorey tree, widespread in forests of Mistbelt and Low Country, *275*

Apodytes *E. Mey. ex Arn.*
dimidiata *E. Mey. ex Arn.* subsp. dimidiata, medium-size tree, widespread and common in forests, thickets and woodlands, especially Forest and Mesic Thicket of Mistbelt and Low Country, *666*

Pyrenacantha *Wight*
grandiflora *Baill.*, thick-branched climber, rare in rocky xeric thickets of Upper Foothills, *1892*

SAPINDACEAE

Allophyllus *L.*
'complex', small to large tree, infrequent but widespread in Forest and Mesic Thicket of Mistbelt and Low Country:
cf. decipiens *(Sond.) Radlk., 2187*
melanocarpus *(Sond.) Radlk., 1576*
transvaalensis *Burtt Davy, 1129*

Pappea *Eckl. & Zeyh.*
capensis *Eckl. & Zeyh.*, occasional small shrub in rocky woodlands, thickets and forests, Low Country, *1705*

MELIANTHACEAE

Bersama *Fres.*
transvaalensis *Turrill*, fairly large occasional tree of rocky forests and woodlands, Mistbelt and Low Country, *1455*
tysoniana *Oliv.*, small tree, infrequent in forests of Mountain and Escarpment Slopes, *1957*

GREYIACEAE

Greyia *Hook. & Harv.*
radlkoferi *Szyszyl.*, small tree of Mistbelt lithosere, occurring as pioneer on sheet-rock formations and persisting in forests, *1563*

BALSAMINACEAE

Impatiens *L.*
hochstetteri *Warb.* subsp. hochstetteri, soft herb, localized in moist field layer of riparian forests, Mountain and Escarpment Slopes, *1013*

RHAMNACEAE

Ziziphus *Mill.*
mucronata *Willd.* subsp. mucronata, small straggly tree, common in woodlands and thickets, especially Low Country and Transitional Mistbelt, *700*

Berchemia *Neck. ex DC.*
zeyheri *(Sond.) Grubov*, small tree, infrequent in forests and thickets of Lower Foothills, *1713*

Scutia *(Comm. ex DC.) Brongn.*

myrtina *(Burm. f.) Kurz*, robust scandent shrub, common in High Forest of Mountain Slopes, *2195*

Rhamnus *L.*

prinoides *L'Hérit.*, infrequent shrub in woodlands and forests, Mistbelt, *959*

Phylica *L.*

paniculata *Willd.*, infrequent shrub of broken lithoseral thickets, Plateau Crest, *1227*

VITACEAE

Rhoicissus *Planch.*

revoilii *Planch.*, robust woody liane of High Forest, Mountain Slopes

rhomboidea *(E. Mey. ex Harv.) Planch.*, robust woody liane, frequent in forests and thickets of Mistbelt and Low Country, *2048*

tomentosa *(Lam.) Wild & Drumm.*, robust woody liane, frequent in forests and thickets of Escarpment Slopes and Foothills, *705*

tridentata *(L. f.) Wild & Drumm.*, small shrub, frequent in forests, woodlands and thickets of Mistbelt and Low Country, *128*

Cyphostemma *(Planch.) Alston*

anatomicum *(C.A. Sm.) Wild & Drumm.*, occasional liane, scattered in Mistbelt lithosere, *1392*

simulans *(C.A. Sm.) Wild & Drumm.*, rare twiner of xeric thickets, Lower Foothills, *1878*

woodii *(Gilg & Brandt) Descoings*, soft perennial forb, infrequent in lithoseral shrublands and woodlands, mainly Low Country, *810*

TILIACEAE

Corchorus *L.*

confusus *Wild*, rare forb in xeric thickets, Upper Foothills, *741*

sp., infrequent forb in grassy field layer of open woodlands, Upper Foothills, *1903*

Sparrmannia *L. f.*

ricinocarpa *(Eckl. & Zeyh.) Kuntze*, infrequent undershrub in low thickets, Mountain Slopes, *1592*

Grewia *L.*

monticola *Sond.*, small tree, localized in rocky woodlands of Low Country, *1697*

occidentalis *L.*, common and widespread shrubby tree of forests, thickets and woodlands, Mistbelt and Low Country, *657*

Triumfetta *L.*

pilosa *Roth*

var. effusa *(E. Mey. ex Harv.) Wild*, annual forb, scattered in Low Country thickets and fairly localized in woodlands of Humid Mistbelt, *627*

var. pilosa, annual forb, widespread in Low Country woodlands and thickets, *733*

var. tomentosa *Szyszyl. ex Sprague & Hutch.*, annual forb, localized in xeric thickets of Upper Foothills, *1803*

rhomboidea *Jacq.*, annual forb, widespread and infrequent in woodlands and thickets of Mistbelt and Low Country, *685*

welwitschii *Mast.* var. hirsuta *(Sprague & Hutch.) Wild*, perennial forb, mainly localized in dolomite-soil grasslands of Plateau Interior, *1323*

MALVACEAE

Abutilon *Mill.*

sonneratianum *(Cav.) Sweet*, robust herb, infrequent in sheltered woodlands of Low Country, *835*

Sida *L.*

dregei *Burtt Davy*, infrequent forb of xeric thickets, Lower Foothills, *871*

Pavonia *Cav.*

columella *Cav.*, large shrubby forb in moist disturbed field layer of Low Country forests, *1925*

Hibiscus *L.*

aethiopicus *L.* var. ovatus *Harv.*, subwoody forb, localized in Mistbelt grasslands, especially Plateau Interior, *1531*

surattensis *L.*, subwoody forb, infrequent in disturbed woodlands of Upper Foothills, *607*

STERCULIACEAE

Dombeya *Cav.*

rotundifolia *(Hochst.) Planch.* var. rotundifolia, small tree, frequent to abundant (often dominant) in Woodland and Xeric Thicket of Low Country, *424*

pulchra *N.E. Br.*, widespread occasional shrub of forests, thickets and woodlands, Mistbelt and Low Country, *611*

Hermannia *L.*

grandiflora *N.E. Br.*, infrequent but widespread trailing forb of disturbed woodlands, especially Low Country, *617*

lancifolia *Szyszyl.*, infrequent forb of Mistbelt grasslands, *1315*

montana *N.E. Br.*, localized forb of Mountain Slopes grasslands, *1490*

Waltheria *L.*

indica *L.*, large shrubby forb of lithoseral woodlands, Low Country, *785*

Sterculia *L.*

murex *Hemsl.*, large canopy tree, widespread in woodlands and thickets of Low Country, *2033*

OCHNACEAE

Ochna *L.*

arborea *Burch. ex. DC.* var. arborea, fairly large understorey tree, frequent (often dominant) in forests of Mountain Slopes, *2163*

gamostigmata *Du Toit*, small shrub, localized and common in mesic thickets of Transitional Mistbelt and Low Country, *632*

holstii *Engl.*, medium-size understorey tree of forests and woodlands, Humid Mistbelt, *915*

natalitia *(Meisn.) Walp.*, small shrub, widespread in grasslands, woodlands, thickets and forests of Mistbelt and Low Country, *778*

CLUSIACEAE

Hypericum *L.*

aethiopicum *Thunb.* subsp. sonderi *(Bred.) N.K.B. Robson*, small subwoody forb, infrequent in Plateau Crest grasslands, *1642*

lalandii *Choisy*, small perennial herb, localized in moist grasslands, Summit Plateau, *2565*

revolutum *Vahl*, bushy shrub, locally abundant in riparian woodlands of forest margins, Summit, *2125*

sp., shrub of riparian woodlands, Summit Plateau, *2131*

FLACOURTIACEAE

Rawsonia *Harv. & Sond.*

lucida *Harv. & Sond.*, understorey tree, infrequent in forests of Escarpment and Mountain Slopes, *970*

Kiggelaria *L.*

africana *L.*, fairly large canopy tree, frequent in forests of Escarpment and Mountain Slopes, *989*

Scolopia *Schreb.*

mundii *(Eckl. & Zeyh.) Warb.*, infrequent shrub of kloof forests, Mountain and Escarpment Slopes, *993*

zeyheri *(Nees) Harv.*, small to large tree, apparently localized and infrequent in Low Country woodlands and thickets, *1720*

Trimeria *Harv.*

grandifolia *(Hochst.) Warb.*, understorey tree, common and abundant in Forest and Mesic Thicket of Mistbelt and Low Country, excluding Plateau Crest forests, *664*

Flacourtia *Comm. ex L'Hérit.*

indica *(Burm. f.) Merr.*, infrequent shrub in mesic woodlands of Low Country, *813*

Dovyalis *E. Mey. ex Arn.*

lucida *Sim*, small tree or shrub, widespread in forests of Mountain Slopes, *1360*

zeyheri *(Sond.) Warb.*, small tree or shrub, infrequent in Short (cliff) Forest of Lower Mountain Slopes, *1386*

PASSIFLORACEAE

Adenia *Forssk.*

digitata *(Harv.) Engl.*, widespread and infrequent herbaceous twiner in forests, thickets and woodlands, mainly Low Country, *382*

gummifera *(Harv.) Harms* var. gummifera, occasional climber in Mistbelt and Low Country thickets, *1917*

Passiflora *L.*

*edulis *Sims*, naturalized exotic climber, common in mesic thickets of Transitional Mistbelt and Low Country, *654*

BEGONIACEAE

Begonia *L.*

sp., occasional perennial herb in moist shady rock crevices, Humid Mistbelt

OLINIACEAE
Olinia *Thunb.*
emarginata *Burtt Davy*, fairly frequent understorey and canopy tree of Tall (often riparian) Forest, Upper Mountain and Summit Slopes, *2155*

THYMELAEACEAE
Peddiea *Harv.*
africana *Harv.*, small localized tree, common in Forest and Mesic Thicket of Mistbelt and Low Country, *719*
Gnidia *L.*
caffra *Meisn.*, infrequent subwoody forb in grasslands, shrublands and woodlands of Sub-Humid Mistbelt and Low Country, *634*
kraussiana *Meisn.* var. kraussiana, infrequent subwoody forb of Sub-Humid Mistbelt and Low Country woodlands, *1815*
microcephala *Meisn.*, infrequent subwoody forb of moist Escarpment Plateau grasslands, *1653*
nodiflora *Meisn.*, infrequent subwoody forb of shallow rocky sites, Summit Slopes shrublands, *2404*
sp., subwoody forb of Mistbelt grasslands, includes *976, 1461*
Passerina *L.*
montana *Thoday*, ericoid shrub, infrequent in rocky shrublands, Summit Plateau

RHIZOPHORACEAE
Cassipourea *Aubl.*
gerrardii *(Schinz) Alston*, frequent (sometimes dominant) understorey tree in forests of Mountain and Escarpment Upper Slopes, *1060*

COMBRETACEAE
Combretum *Loefl.*
apiculatum *Sond.* subsp. apiculatum, medium-sizc canopy tree, occasional in woodlands of Low Country, *845*
collinum *Fresen.*
subsp. gazense *(Swynn. & Bak. f.) Okafor*, medium-size canopy tree, localized in woodlands of Lower Foothills
subsp. suluense *(Engl. & Diels) Okafor*, localized canopy tree of Low Country woodlands and thickets, *829A*
kraussii *Hochst.*, large canopy tree, common in Forest and Mesic Thicket of Mistbelt and Low Country, *861*
molle *R. Br. ex G. Don*, widespread small tree, especially common in Woodland and Xeric Thicket of Low Country, *631*
sp., large waterside tree of Low Country forests, *887*
zeyheri *Sond.*, fairly small tree of Low Country woodlands and thickets, *843*
Quisqualis *L.*
parviflora *Gerr. ex Harv.*, occasional scandent shrub of High Forest, Upper Mountain Slopes, *2108*
Terminalia *L.*
phanerophlebia *Engl. & Diels*, small infrequent tree of sheltered xeric woodlands, Low Country, *862*
sericea *Burch. ex DC.*, medium-size canopy tree, scattered in Low Country woodlands, *1758*

MYRTACEAE
Psidium *L.*
*guajava *L.*, small spreading exotic tree, widespread and naturalized from cultivation
Eugenia *L.*
natalitia *Sond.*, small understorey tree, widespread and fairly common in forests and mesic thickets, especially Escarpment Slopes, *884*
Syzygium *Gaertn.*
cordatum *Hochst.*, variable abundant tree, large in sheltered forests, thickets and woodlands below Escarpment Plateau; but stunted in rocky woodlands of Plateau Crest, *883*
gerrardii *(Harv. ex Hook. f.) Burtt Davy*, large canopy and emergent tree, mainly localized in forests of Humid Mistbelt, *909*
guineense *(Willd.) DC.*, small tree associated with S. cordatum in rocky woodlands of Plateau Crest, *2721*
Heteropyxis *Harv.*
natalensis *Harv.*, widespread medium-size tree, mainly localized in forests, thickets and woodlands of Low Country, *608*

MELASTOMATACEAE
Dissotis *Benth.*
phaeotricha *(Hochst.) Hook. f.* var. phaeotricha, large forb, infrequent in Transitional Mistbelt grasslands, *1967*

HALORAGACEAE
Gunnera *L.*
perpensa *L.*, large perennial rhizomatous herb, abundant in marshy grasslands of Summit Plateau, *2576*

ARALIACEAE
Schefflera *J.R. & G. Forst.*
umbellifera *(Sond.) Baill.*, localized canopy tree of Mistbelt forests; Plateau Crest and Escarpment Slopes, *1009*
Cussonia *Thunb.*
spicata *Thunb.*, canopy and emergent tree, common and widespread in forests, thickets and woodlands of Mistbelt and Low Country, *Scheepers 392*

APIACEAE
Sanicula *L.*
elata *Buch.-Ham.*, perennial herb of moist forest floor, Mountain and Escarpment Slopes, *1011*
Alepidea *De la Roche*
amatymbica *Eckl. & Zeyh.* var. amatymbica, perennial herb, infrequent on Summit stream banks, *2739*
basinuda *Pott* var. basinuda, perennial herb, rare in Plateau Crest and Summit Plateau grasslands, *1203*
gracilis *Duemmer* var. major *Weim.*, common perennial herb, localized in grasslands and woodlands of Humid Mistbelt, *1492*
longifolia *E. Mey.* subsp. longifolia, perennial herb confined to rocky woodlands, Summit, *2298*
sp., perennial herb in grasslands of Summit Slopes and Peaks, *2407*
Heteromorpha *Cham. & Schlechtd.*
pubescens *Burtt Davy*, widespread infrequent shrub of woodlands, Mistbelt and Low Country, *1808*
transvaalensis *Schltr. & Wolff*, infrequent subwoody forb in burnt woodlands, Escarpment Upper Slopes, *1645*
trifoliata *(Wendl.) Eckl. & Zeyh.*, small infrequent tree of woodlands and forests, Humid Mistbelt, *991*
Pimpinella *L.*
transvaalensis *Wolff*, infrequent perennial herb of rocky woodlands, Lower Mountain Slopes, *1514A*
Sium *L.*
repandum *Welw. ex Hiern*, robust aquatic herb in riparian woodlands, Summit Plateau, *2127*
Annesorrhiza *Cham. & Schlechtd.*
flagellifolia *Burtt Davy*, perennial herb, infrequent in rocky shrublands, Summit Plateau, *2465*
Peucedanum *L.*
capense *(Thunb.) Sond.* var. capense, shrubby forb, infrequent in disturbed thickets of Mountain Slopes, *1604*
magalismontanum *Sond.*, infrequent perennial herb, widespread in grasslands and woodlands of Mistbelt and Low Country, *1087*
sp., localized perennial herb of Summit Peak grasslands, *2408, 2472*

ERICACEAE
Vaccinium *L.*
exul *H. Bol.*, small shrub, frequent amongst rocks, Summit, *2306*
Erica *L.*
atherstonei *Diels ex Guth. & Bol.*, small shrub, common in rocky shrublands, Summit Peaks and Slopes, *2613*
caffrorum *H. Bol.* var. caffrorum, localized shrub of rocky knolls, Summit Slopes and Peaks, *2304*
cerinthoides *L.*, localized shrublet of exposed stoney slopes, Summit, *Weisser 9037*
drakensbergensis *Guth. & Bol.*, localized shrub, scattered in grasslands, shrublands and woodlands of Mistbelt, *1584*
sp., small shrub of Low Open (grassy) shrubland, Summit Slopes, *2362*
woodii *H. Bol.*, infrequent shrub of Mountain Slopcs and Summit grasslands, *1480*

MYRSINACEAE
Maesa *Forssk.*
lanceolata *Forssk.* var. rufescens *(A. DC.) Taton*, small tree, common in understorey (or as pioneer) of Forest and Mesic Thicket of Mistbelt and Low Country, *923*

Myrsine *L.*
africana *L.*, small shrub, common in rocky shrublands, woodlands and forests of Mistbelt, *1193*
Rapanea *Aubl.*
melanophloeos *(L.) Mez*, medium-size understorey tree of (mainly) Mistbelt forests, thickets and woodlands, *965*

SAPOTACEAE
Bequaertiodendron *De Wild.*
magalismontanum *(Sond.) Heine & J.H. Hemsl.*, large tree-like shrub common in forests, thickets and woodlands below Escarpment Plateau, and especially localized in rocky woodlands of Plateau Crest, *2015*
Mimusops *L.*
zeyheri *Sond.*, fairly large tree, apparently confined to moist rocky thickets and forests of Low Country, *1712*

EBENACEAE
Euclea *Murray*
'complex', widespread small understorey tree, mainly in woodlands and thickets of Transitional Mistbelt and Low Country:
crispa *(Thunb.) Guerke* subsp. crispa, *918*
divinorum *Hiern, 28*
schimperi *(A. DC.) Dandy* var. schimperi, *633*
natalensis *A. DC.*, infrequent small tree of Low Country forests, thickets and woodlands, *833*
Diospyros *L.*
galpinii *(Hiern) De Winter*, low shrublet of Mistbelt grasslands and open woodlands, *1415*
lycioides *Desf.* subsp. sericea *(Bernh.) De Winter*, widespread small tree, abundant in less-shaded forests, thickets, woodlands and grasslands of Mistbelt and Low Country, *624*
mespiliformis *Hochst. ex A. DC.*, large localized tree, infrequent in low Country woodlands and thickets. often associated with diabase outcrops and termitaria, *1980C*
whyteana *(Hiern) F. White*, frequent shrub, widespread (often dominant) in forests, thickets and woodlands of Mistbelt and Low Country, also as pioneer in broken lithosere, *612*

OLEACEAE
Schrebera *Roxb.*
alata *(Hochst.) Welw.*, fairly large canopy tree, infrequent in forest of Escarpment Slopes, *1068*
Chionanthus *L.*
foveolata *(E. Mey.) Stearn*
subsp. foveolata, fairly large tree, infrequent in forests of Mistbelt and Low Country, *1848*
subsp. major *(Verdoorn) Stearn*, large tree in Tall Forest, Mountain Slopes, *2283*
Olea *L.*
capensis *L.* subsp. macrocarpa *(C.H. Wr.) Verdoorn*, fairly large canopy tree, common (often dominant) in forests of Mountain Slopes, *1357*
europaea *L.* subsp. africana *(Mill.) P.S. Green*, small tree, localized in understorey of Short (cliff) Forest, Lower Mountains, *1393*
Jasminum *L.*
angulare *Vahl*, fairly frequent shrub of High Forest, Lower Mountain Slopes, *2201*
sp., twiner of Tall Forest, Escarpment Slopes, includes *962A*
streptopus *E. Mey.*, localized twiner of forests and thickets, Lower Mountain and Escarpment Slopes, *916*

LOGANIACEAE
Strychnos *L.*
madagascariensis *Poir.*, small tree, mainly localized in woodlands of Lower Foothills, *1750*
spinosa *Lam.*, small tree, fairly common in Low Country woodlands and thickets; occasionally in broken lithosere, Mistbelt, *1751*
Anthocleista *Afzel. ex R. Br.*
grandiflora *Gilg*, tall canopy and emergent tree, common in forests and mesic thickets of Transitional Mistbelt and Low Country, *Scheepers 797*
Nuxia *Comm. ex Lam.*
congesta *R. Br. ex Fresen.*, fairly small tree, infrequent in rocky woodlands of Plateau Crest, *1071*
Buddleja *L.*
auriculata *Benth.*, localized shrub of moist (often riparian) forests, Mountain and Summit Slopes, *1373*
salviifolia *(L.) Lam.*, occasional shrub of rocky woodlands and moist (often riparian) forests, Mountain and Summit Slopes, *2067*

GENTIANACEAE
Sebaea *Soland. ex R. Br.*
leiostyla *Gilg*, infrequent perennial forb of Mountain and Summit grasslands, *1472*

APOCYNACEAE
Carissa *L.*
bispinosa *(L.) Desf. ex Brenan* var. acuminata *(E. Mey.) Codd*, widespread and common shrub in undergrowth of Forest and Mesic Thicket of Mistbelt and Low Country, *92*
Rauvolfia *L.*
caffra *Sond.*, large canopy tree, infrequent in moist forests of Escarpment Slopes, *211*

PERIPLOCACEAE
Cryptolepis *R. Br.*
oblongifolia *Schltr.*, subwoody half-twining forb, common and widespread in Woodland and Xeric Thicket of Low Country, and fairly frequent in lithoseral grasslands and woodlands of Humid Mistbelt, *1032*
Raphionacme *Harv.*
elata *N.E. Br.*, localized forb of dolomite-soil grasslands, Plateau Interior, *1343*
hirsuta *(E. Mey.) R.A. Dyer ex Phill.*, widespread forb in grasslands of Humid Mistbelt, *1169*

ASCLEPIADACEAE
Xysmalobium *R. Br.*
aceratoides *(Schltr.) N.E. Br.*, prostrate perennial forb, widespread on Summit, *2384*
confusum *Scott Elliott*, robust perennnial forb, rare in grasslands of Lower Mountain Slopes, *1464*
Asclepias *L.*
crassinervis *N.E. Br.*, succulent herb, scattered in woodlands and grasslands of Mistbelt and Low Country, *1351*
dregeana *Schltr.*, rare herb of Mistbelt grasslands, *1352*
Pentarrhinum *E. Mey.*
insipidum *E. Mey.*, vigorous climber, infrequent in xeric thickets of Low Country, *863*
Cynanchum *L.*
ellipticum *(Harv.) R.A. Dyer*, rare twiner of Low Country xeric thickets, *1890*
Sarcostemma *R. Br.*
viminale *(L.) R. Br.*, leafless succulent twiner of sheet-rock shrublands, Transitional Mistbelt, *1955*
Secamone *R. Br.*
alpinii *Schultes*, vigorous slender liane, infrequent in forests and thickets of Escarpment and Mountain Lower Slopes, *917*
gerrardii *Harv. ex Benth.*, slender climber, widespread and common in Forest and Mesic Thicket of Mistbelt and Low Country, *697*
parvifolia *(Oliv.) Bullock*, localized twiner of Transitional Mistbelt thickets, *931*
Ceropegia *L.*
meyeri *Decne.*, infrequent soft twiner of Plateau Crest woodlands, *1444*
racemosa *N.E. Br.* subsp. setifera *(Schltr.) Huber*, a twiner of Transitional Mistbelt mesic thickets, *995*
sp., rare twiner of Low Country xeric thickets, *1875*
woodii *Schltr.*, infrequent soft twiner, widespread in forests of Low Country and in rocky woodlands of Mistbelt, *1457*
Tylophora *R. Br.*
anomala *N.E. Br.*, widespread climber or creeper associated with Low Country lithoseral woodlands and apparently persisting in thickets and forests, *648*
flanaganii *Schltr.*, slender twining liane, occasional in Forests of Mountain Slopes, *1569*
Pergularia *L.*
daemia *(Forssk.) Chiov.* var. daemia, infrequent creeper of disturbed thickets, Upper Foothills, *1810*

CONVOLVULACEAE
Cuscuta *L.*
sp., twining parasitic forb, localized in Woodland and Xeric Thicket of Low Country

Ipomoea *L.*
bathycolpos *Hallier f.* var. bathycolpos, infrequent creeper of grasslands and rocky woodlands, Escarpment Plateau, *1178*
crassipes *Hook.*, infrequent perennial forb, localized in woodlands and thickets of Upper Foothills, *640*
sp., scrambler or twiner in Low Country woodlands, includes *1745, 1904*

BORAGINACEAE
Ehretia *P. Br.*
amoena *Klotzsch*, infrequent shrub of Low Country xeric woodlands, *748A*

VERBENACEAE
Lantana *L.*
*camara *L.*, fairly common naturalized shrub, especially in Low Country woodlands, *949*
mearnsii *Moldenke* var. latibracteolata *Moldenke*, small soft shrub, infrequent in mesic thickets of Transitional Mistbelt, *1072*
Lippia *L.*
javanica *(Burm. f.) Spreng.*, widespread small shrub (possibly a forest prescursor), especially Mistbelt grasslands, *734*
wilmsii *H. Pearson*, infrequent forb of disturbance, localized in Upper Foothill woodlands and thickets, *742*
Clerodendrum *L.*
glabrum *E. Mey.* var. glabrum, widespread small tree, infrequent in woodlands and forests of Mistbelt and Low Country, *1442*
myricoides *(Hochst.) Vatke*, canopy tree in forests of Escarpment Slopes or understorey shrub in woodlands, thickets and forests of Foothills, *1137*
sp., infrequent shrub or forb in woodlands and thickets of Foothills, includes *1723, 1819*
suffruticosum *Guerke* var. suffruticosum, infrequent shrub associated with sheet-rock formations, Transitional Mistbelt, *1050*
triphyllum *(Harv.) H. Pearson* var. triphyllum, subwoody perennial forb, infrequent in Summit Plateau grasslands, *2537*

LAMIACEAE
Acrotome *Benth.*
hispida *Benth.*, infrequent forb, localized mainly in dolomite-soil grasslands of Plateau Interior, *1307*
Leonotis *(Pers.) R. Br.*
'complex', soft shrubby perennial, widespread in thickets, woodlands and grasslands of Mistbelt and Low Country:
ocymifolia *(Burm. f.) Iwarsson*
var. ocymifolia, *2305*
var. raineriana *(Visiani) Iwarsson*, *739*
sp., rare herb of Transitional Mistbelt woodlands, *1053*
Stachys *L.*
grandifolia *E. Mey. ex Benth.*, soft undershrub, infrequent in moist shady thickets of Upper Foothills, *699*
natalensis *Hochst.* var. galpinii *(Briq.) Codd*, infrequent forb of rocky woodlands, Lower Mountain Slopes, *1498*
nigricans *Benth.*, slender forb, localized in grasslands of Escarpment Plateau and Slopes, *1259*
Tetradenia *Benth.*
'eomplex', small soft shrub, widespread as chasmophyte in early lithosere and persisting in lithoseral woodlands and thickets from Foothills to Plateau Crest:
brevispicata *(N.E. Br.) Codd, 777*
riparia *(Hochst.) Codd, 397*
Aeollanthus *Mart. ex K. Spreng.*
rehmannii *Guerke*, shrubby herb, localized in rocky woodlands of Escarpment Slopes and Plateau Crest, *1408*
Endostemon *N.E. Br.*
obtusifolius *(E. Mey. ex Benth.) N.E. Br.*, infrequent soft shrub of mesic woodlands and thickets, Transitional Mistbelt, *929*
Pycnostachys *Hook.*
reticulata *(E. Mey.) Benth.*, tall shrubby forb of retarded grasslands, Summit Plateau, *2726*
urticifolia *Hook.*, soft shrub, widespread in lithoseral woodlands and thickets of Upper Foothills and Escarpment Lower Slopes, *614B*
Plectranthus *L'Hérit.*
ciliatus *E. Mey. ex Benth.*, infrequent shrub of High Forest, Mountain Slopes, *2208*
fruticosus *L'Hérit.*, soft undershrub of rocky forests and woodlands, Plateau Crest, *1439*
grandidentatus *Guerke*, shaded understorey shrub, infrequent in lithoseral woodlands and forests of Plateau Crest and Mountain Slopes, *1560*
hadiensis *(Forssk.) Schweinf. ex Spreng.* var. hadiensis, localized shrub (chasmophyte) of Plateau Crest open woodlands, *1425*
laxiflorus *Benth.*, infrequent soft undershrub of Transitional Mistbelt forests, *1958*
rubropunctatus *Codd*, soft undershrub, sometimes forming pure stands in shrub layer of rocky forests and riparian woodlands of Escarpment and Summit Plateau, occasionally a pioneer in Mistbelt sheet-rock formations, *1508*
sp., widespread shrub of forests, thickets, woodlands and grasslands, includes *834, 1379*
spicatus *E. Mey. ex Benth.*, succulent herb in soil pockets of sheet-rock formations, Low Country, *1880*
verticillatus *(L. f.) Druce*, usually a lax succulent herb covering rocks in shade of Low Country forests, *1714*
Rabdosiella *Codd*
calycina *(Benth.) Codd*, subwoody perennial forb, widespread in fire-protected shrublands and woodlands, Summit, *2318*
Hoslundia *Vahl*
opposita *Vahl*, tall shrubby forb, rare in Low Country woodlands, *1869*
Hemizygia *(Benth.) Briq.*
albiflora *(N.E. Br.) Ashby*, low bush of rocky shrublands and grasslands, especially windy sites with shallow soil, Summit Slopes and Peaks, *2405*
canescens *(Guerke) Ashby*, variable forb of lithoseral woodlands, Plateau Crest and Foothills, *1764*
subvelutina *(Guerke) Ashby*, localized forb, common in grasslands of Escarpment Plateau and Slopes, *533*
transvaalensis *(Schltr.) Ashby*, widespread forb of woodlands and grasslands, Mistbelt and Low Country, *1290*
Ocimum *L.*
urticifolium *Roth.*, infrequent forb of xeric woodlands and thickets, Low Country, *791*
Becium *Lindl.*
obovatum *(E. Mey. ex Benth.) N.E. Br.* var. obovatum, localized herb, common in grasslands of Escarpment Plateau and Slopes, *1083*

SOLANACEAE
Solanum *L.*
*mauritianum *Scop.*, naturalized small tree, common as a weed of timber plantations and often encroaching on indigenous woodlands and forests, especially Mistbelt
sp. cf. aculeastrum *Dun.*, small shrub of sheet-rock formations and disturbed forest openings, Low Country
terminale *Forssk.* subsp. terminale, subwoody climber of Tall (kloof) Forest, Upper Mountain Slopes, *2153*

SCROPHULARIACEAE (Part A)
Nemesia *Vent.*
rupicola *ined.*, infrequent herb of riparian woodlands, Summit Plateau, *2706*
Diclis *Benth.*
reptans *Benth.*, small herb of riparian forests and woodlands, Summit Plateau and Slopes, *2121*
Halleria *L.*
lucida *L.*, small tree, widespread from Low Country forests to Mistbelt forests, thickets and woodlands, *1404B*
Phygelius *E. Mey. ex Benth.*
aequalis *Harv. ex Hiern*, waterside shrub of riparian woodlands, Summit Plateau, *2130*
Bowkeria *Harv.*
cymosa *Macowan*, small tree, localized in rocky Mountain forests and woodlands, *1513A*
Sutera *Roth*
grandiflora *(Galpin) Hiern*, infrequent forb of Low Country woodlands, *855*
Zaluzianskya *F.W. Schmidt*
spathacea *(Benth.) Walp.*, infrequent forb of moist grasslands, Summit Plateau, *2689*
Ilysanthes *Rafin.*
wilmsii *Engl. ex Diels*, semi-aquatic herb in shallow pools of sheet-rock formations, Low Country, *1916*

SELAGINACEAE
Hebenstretia *L.*
comosa *Hochst.*, occasional herb in Summit grasslands, *2377*
oatesii *Rolfe*, large herb, locally abundant in riparian woodlands, Summit Plateau, *2437*
Selago *L.*
atherstonei *Rolfe*, infrequent subwoody forb of lithoseral grasslands and woodlands, Mistbelt, *536*
elata *Rolfe*, rare shrubby forb in grasslands of Transitional Mistbelt, *1964*
hyssopifolia *E. Mey.*, infrequent subwoody forb, localized in lithoseral woodlands of Plateau Crest, *1424*
lydenburgensis *Rolfe*, subwoody forb, infrequent in grasslands of Summit Slopes, *2688*
muddii *Rolfe*, subwoody forb, localized mainly in Plateau Crest grasslands, *1098*
sp., infrequent subwoody forb of Protea woodland, Summit Slopes, *2417*
Tetraselago *Junell*
natalensis *(Rolfe) Junell*, subwoody forb, localized in lithoseral grasslands and woodlands of Plateau Crest and Escarpment Slopes, *1111*
wilmsii *(Rolfe) Hilliard & Burtt*, widespread subwoody forb of shallow rocky soils, Summit grasslands, shrublands and woodlands, *2301*

SCROPHULARIACEAE (Part B)
Alectra *Thunb.*
sessiliflora *(Vahl) Kuntze* var. sessiliflora, apparently rare parasitic herb in grasslands of Mountain Slopes, *1486*
Sopubia *Buch.-Ham. ex D. Don*
cana *Harv.* var. cana, frequent forb in grasslands of Summit and Mountain Slopes, *1470*
simplex *(Hochst.) Hochst.*, infrequent forb of moist grasslands, Summit Plateau, *2568*
Buchnera *L.*
dura *Benth.*, infrequent forb in grasslands of Lower Mountain Slopes, *1491*
longispicata *Schinz*, rare forb of Low Country woodlands, *1763*
Cycnium *E. Mey. ex Benth.*
racemosum *Benth.*, subwoody forb, common on shallow rocky soils, Summit grasslands, shrublands and woodlands, *2378*
tubulosum *(L. f.) Engl.*, small rare herb of disturbed grasslands, Plateau Crest, *1293*
Striga *Lour.*
bilabiata *(Thunb.) Kuntze*, small hemi-parasitic herb, rare in grasslands of Escarpment Slopes, *1346*

BIGNONIACEAE
Tecomaria *Spach.*
capensis *(Thunb.) Spach.*, small scandent shrub or tree, infrequent in shrub layer and understorey of lithoseral woodlands, thickets and forests, Mistbelt and Low Country, *1404*
Jacaranda *Juss.*
*mimosifolia *D. Don.*, occasional exotic tree, naturalized in mesic thickets of Low Country, *937*

PEDALIACEAE
Ceratotheca *Endl.*
triloba *(Bernh.) Hook. f.*, tall shrubby forb, common on sheet-rock formations and early lithoseral grasslands and woodlands, Mistbelt and Low Country, *1282*

GESNERIACEAE
Streptocarpus *Lindl.*
cyaneus *S. Moore*, perennial herb, apparently localized in Short (cliff) Forest, Lower Mountain Slopes, *1384*
dunnii *Hook. f.*, localized herb of rocky open shrublands and woodlands, Mistbelt, *1423A*
pentherianus *Fritsch*, epiphyte on trees and rocks of Tall (kloof) Forest, Upper Mountain and Summit Slopes, *2160*
polyanthus *Hook.* subsp. dracomontanus *Hilliard*, infrequent herb of Escarpment Slopes forests, *1062B*

ACANTHACEAE
Thunbergia *Retz.*
atriplicifolia *E. Mey. ex Nees*, infrequent localized twiner in woodlands of Upper Foothills, *643*
neglecta *Sond.*, infrequent twiner of mesic thickets, Upper Foothills, *695*
sp., herb in forests of Escarpment Lower Slopes, includes *986*
Phaulopsis *Willd.*
imbricata *(Forssk.) Sweet*, small undershrub, common in forests, thickets and woodlands of Transitional Mistbelt and Low Country, *600*
Dyschoriste *Nees*
depressa *(L.) Nees*, infrequent forb in shrubby grassland of old-land successions, Upper Foothills, *725*
Chaetacanthus *Nees*
burchellii *Nees*, shrubby forb in field layer of thickets and woodlands, mainly Lower Foothills, *1737*
Ruellia *L.*
sp., rare forb of closed woodlands, Lower Foothills, *1742*
Crabbea *Harv.*
hirsuta *Harv.*, low subwoody forb, scattered in Mistbelt grasslands and Low Country woodlands, *748*
Barleria *L.*
gueinzii *Sond.*, rare shrubby forb in rocky forests, Lower Foothills, *1711*
ovata *E. Mey. ex Nees*, widespread forb of Mistbelt grasslands and woodlands, *1523*
Sclerochiton *Harv.*
harveyanus *Nees*, undershrub, often dominant and abundant in forests of Humid Mistbelt, *1062A*
Dicliptera *Juss.*
clinopodia *Nees*, undershrub, widespread in Forest and Mesic Thicket of Mistbelt and Low Country, *686*
Hypoestes *Soland. ex R. Br.*
aristata *R. Br.*, localized undershrub of closed woodlands and xeric thickets, Low Country, *740*
triflora *(Forssk.) Roem. & Schult.*, localized undershrub of Tall (riparian) Forest, Mountain Slopes, *1570*
Isoglossa *Oerst.*
ciliiana *(Nees) Lindau*, lax subwoody forb, rare in rocky mesic thickets of Upper Foothills, *876*

PLANTAGINACEAE
Plantago *L.*
*major *L.*, waterside herb of Tall (riparian) Forest, Low Country, *901*

RUBIACEAE
Kohautia *Cham. & Schlechtd.*
amatymbica *Eckl. & Zeyh.*, small forb, infrequent in Mistbelt grasslands, *1209*
Conostomium *Cuf.*
natalense *(Hochst.) Brem.* var. glabrum *Brem.*, infrequent forb, scattered in rocky woodlands of Mistbelt and grasslands of Low Country, *1516*
Agathisanthemum *Klotzsch*
bojeri *Klotzsch* var. bojeri, perennial herb, infrequent in grasslands and woodlands of old-land successions, Low Country, *726*
Pentas *Benth.*
sp., rare forb of disturbed woodlands, Upper Foothills, *743*
Breonadia *Ridsdale*
salicina *(Vahl) Hepper & Wood*, large waterside tree, conspicuous in Tall (riparian) Forest of Low Country, *Scheepers 606*
Cephalanthus *L.*
natalensis *Oliv.*, woody liane and scrambler, occasional as chasmophyte in Mistbelt sheet-rock formations, persisting in rocky woodlands of Plateau Crest, and frequent in forests and mesic thickets of Mistbelt, *706*
Burchellia *R. Br.*
bubalina *(L. f.) Sims*, occasional small tree of broken lithoseral woodlands, Mistbelt, *1494*
Coddia *Verdc.*
rudis *(E. Mey. ex Harv.) Verdc.*, occasional undershrub in xeric thickets of Low Country, *1783A*
Rothmannia *Thunb.*
capensis *Thunb.*, canopy and understorey tree of elfin-like forests, Plateau Crest and Mountain Slopes, *1199*
globosa *(Hochst.) Keay*, infrequent shrub or small tree in understorey of mesic thickets, Transitional Mistbelt, *886*
Hyperacanthus *E. Mey. ex Bridson*
amoenus *(Sims) Bridson*, shrub or small tree, fairly frequent in forests and thickets of Low Country, *885*
Oxyanthus *DC.*

speciosus *DC*, subsp. gerrardii *(Sond.) Bridson*, large understorey tree, frequent in forests and mesic thickets of Escarpment and Mountain Slopes, *1014*
Tricalysia *A. Rich.*
'complex', small understorey tree, common in Forest and Mesic Thicket of Mistbelt and Low Country, occasional in rocky woodlands of Plateau Crest:
capensis *(Meisn.) Sim, 1136*
lanceolata *(Sond.) Burtt Davy, 1397*
Kraussia *Harv.*
floribunda *Harv.*, localized undershrub of Low Country forests and sheltered thickets, *1721*
Pentanisia *Harv.*
angustifolia *(Hochst.) Hochst.*, perennial herb, infrequent in Mountain Slopes grasslands, *1473*
prunelloides *(Eckl. & Zeyh.) Walp.*, low perennial herb, widespread and abundant in grasslands of Mistbelt, *676*
Vangueria *Juss.*
infausta *Burch.* subsp. infausta, small tree of Mistbelt and Low Country lithosere, persisting in woodlands and thickets, *790*
Canthium *Lam.*
ciliatum *(Klotzsch) Kuntze*, small understorey tree, localized in Tall forests of Escarpment and Mountain Slopes, *1057*
gilfillanii *(N.E. Br.) O.B. Miller*, shrub or small tree, rare in Low Country woodlands, *829*
gueinzii *Sond.*, woody liane, common in forests and mesic thickets below Escarpment Plateau, *889*
inerme *(L. f.) Kuntze*, shrub or small tree, widespread in forests, thickets and woodlands of Mistbelt and Low Country, *613*
mundianum *Cham. & Schlechtd.*, small tree, scattered in Foothill woodlands and xeric thickets and in Plateau Crest woodlands, *1407*
pauciflorum *(Klotzsch) Kuntze*, understorey tree in High Forest, Upper Mountain Slopes, *2148*
sp., infrequent shrub of Low Country woodlands, *841*
Psydrax *Gaertn.*
livida *(Hiern) Bridson*, shrub or small tree, localized in Short (cliff) Forest of Lower Mountain Slopes, *1371*
locuples *(K. Schum.) Bridson*, rare shrub or small tree in understorey of Mistbelt forests, *1224*
obovata *(Eckl. & Zeyh.) Bridson* subsp. obovata, fairly large understorey tree, infrequent in tall forests of Mountain and Escarpment Slopes, *1168*
Pachystigma *Hochst.*
macrocalyx *(Sond.) Robyns*, infrequent shrub of rocky woodlands, Humid Mistbelt, *1190*
sp., infrequent shrub of early lithoseral woodlands, Lower Foothills, includes *1884*
Fadogia *Schweinf.*
homblei *De Wild.*, infrequent forb in broken lithoseral grasslands, Plateau Crest, *1419*
tetraquetra *Krause*, widepsread forb, common in grasslands and woodlands of Mistbelt, *1448*
Pavetta *L.*
cooperi *Harv. & Sond.*, shrub or small tree, infrequent in Mistbelt forests, *1956*
galpinii *Brem.*, occasional shrub in forests and mesic thickets of Escarpment and Mountain Slopes, *997*
gardeniifolia *A. Rich.* var. gardeniifolia, infrequent shrub, chasmophyte in broken lithoseral woodlands of Transitional Mistbelt, *1632*
gardeniifolia *A. Rich.* var. subtomentosa *K. Schum.*, infrequent shrub, chasmophyte on sheet-rock formations, Low Country, *806.*
schumanniana *F. Hoffm. ex K. Schum.*, fairly frequent shrub or small tree, localized in partially sheltered woodlands and xeric thickets of Lower Foothills, *784*
sp., variable shrub of forests and thickets, Low Country, includes *1847*
Psychotria *L.*
capensis *(Eckl.) Vatke*, small tree, widespread and abundant in Forest and Mesic Thicket of Mistbelt and Low Country and in Humid Mistbelt woodlands, *971*
zombamontana *(Kuntze) Petit*, small understorey tree, frequent in Mistbelt forests, *2053*
Galopina *Thunb.*
aspera *(Eckl. & Zeyh.) Walp.*, infrequent forb, scattered in grasslands and woodlands of Humid Mistbelt, *1540*
circaeoides *Thunb.*, widespread perennial herb, common in undergrowth of forests, thickets and woodlands, Mistbelt and Low Country, *691*
Anthospermum *L.*
herbaceum *L. f.*, herbaceous bushy perennial, scattered in Summit grasslands and woodlands, *2329*
welwitschii *Hiern*, ericoid shrub, occasional in woodlands of Plateau Crest and Escarpment Slopes, *1627*
Richardia *L.*
*brasiliensis *Gomes*, naturalized herb of old-land disturbance, Upper Foothills, *626*
Spermacoce *Gaertn.*
natalensis *Hochst.*, rare forb, chasmophyte in broken lithoseral woodlands of Plateau Crest, *1454*
Rubia *L.*
cordifolia *L.* subsp. conotricha *(Gand.) Verdc.*, herbaceous perennial creeper, infrequent in xeric thickets of Low Country, *851*
petiolaris *DC.*, herbaceous perennial climber, rare in Low Country woodlands, *1805*

VALERIANACEAE
Valeriana *L.*
capensis *Thunb.*, localized perennial forb in association with Andropogon appendiculatus vleis, Summit, *2582*

DIPSACACEAE
Cephalaria *Schrad.*
pungens *Szabo*, fairly widespread herb, localized and common, mainly in grasslands of Humid Mistbelt, *1471*
Scabiosa *L.*
columbaria *L.*, infrequent perennial herb of grasslands, Summit and Escarpment Plateau, *747*

CUCURBITACEAE
Momordica *L.*
balsamina *L.*, slender twiner, infrequent in sheltered xeric thickets of Low Country, *865*
boivinii *Baill.*, infrequent soft twiner, localized in rocky (diabase) woodlands of Low Country, *1697A*
Cucumis *L.*
sp., occasional creeper in Low Country rocky thickets, *1368*
zeyheri *Sond.*, infrequent creeper in dolomite-soil grasslands, Plateau Interior, *1368*
Trochomeria *Hook. f.*
sagittata *(Harv. ex Sond.) Cogn.*, infrequent slender twiner of rank grasslands, Upper Foothills, *1935*
Coccinia *Wight & Arn.*
palmata *(Sond.) Cogn.*, infrequent herbaceous climber, localized in mesic thickets of Transitional Mistbelt, *892*

CAMPANULACEAE
Wahlenbergia *(Schrad. ex Roth)*
huttonii *(Sond.) Thulin*, infrequent perennial herb of Mistbelt grasslands, *1308*
lycopodioides *Schltr. & V. Brehm.*, infrequent herb of lithoseral grasslands, Plateau Crest, *1636*
undulata *(L. f.) A. DC.*, subwoody herb, infrequent in lithoseral grasslands of Humid Mistbelt, *1550*
virgata *Engl.*, subwoody herb, widespread in grasslands of Plateau Crest and Summit, *1175*
Craterocapsa *Hilliard & Burtt*
tarsodes *Hilliard & Burtt*, widespread low perennial herb in grasslands of Summit Slopes and Plateau, *2515*

LOBELIACEAE
Cyphia *Berg.*
elata *Harv.*
'complex', occasional forb, scattered in Mistbelt grasslands and woodlands:
var. elata *Harv., 441*
var. glabra *Harv., 1416*
stenopetala *Diels*, rare slender herb of retarded grasslands, Summit Plateau, *2532*
Lobelia *L.*
erinus *L.*, rare herb of Summit Plateau grasslands, *2558*
flaccida *(Presl) A. DC.* subsp. flaccida, small herb of disturbed grasslands, Summit Peak, *2720*
Monopsis *Salisb.*
decipiens *(Sond.) Thulin*, small infrequent herb in moist grasslands of Escarpment Slopes and Plateau Crest, *1092*

ASTERACEAE
Vernonia *Schreb.*
adoensis *Sch. Bip. ex Walp.*, small infrequent shrub, widely scattered in Mistbelt grasslands and thickets, *942*
amygdalina *Del.*, large herb, infrequent in field layer of mesic thickets, Upper Foothills, *703*
centaureoides *Klatt*, infrequent forb in rank grasslands of Upper Foothills, *1930*
colorata *(Willd.) Drake*, small shrub, localized in rocky (diabase) woodlands of Lower Foothills, *1700*
hirsuta *(DC.) Sch. Bip.*, subwoody forb, widespread in Mistbelt grasslands and shrublands, *1477*
natalensis *Sch. Bip.*, widespread subwoody forb of grasslands and woodlands, Mistbelt and Low Country, *1474*
neocorymbosa *Hilliard*, fairly common subwoody forb, localized in woodlands of Escarpment Slopes and Upper Foothills, *1624B*
oligocephala *(DC.) Sch. Bip. ex Walp.*, shrubby forb, scattered in woodlands and thickets of Mistbelt and Low Country, *815*
poskeana *Vatke & Hildebr.* subsp. botswanica *Pope*, widespread forb of lithoseral woodlands and grasslands, Mistbelt and Low Country, *804*
stipulacea *Klatt*, widespread robust shrub of forests, thickets and woodlands, mainly Low Country, *1405*
thodei *Phill.*, occasional forb of retarded grasslands, Summit Plateau, *2353*
wollastonii *S. Moore*, occasional undershrub in forests of Plateau Crest and Mountain Slopes, *1195*
Ageratum *L.*
*conyzoides *L.*, forb of disturbed woodlands, Low Country, *864*
Stomatanthes *R.M. King & H. Robinson*
africanus *(Oliv. & Hiern) R.M. King & H. Robinson*, subwoody forb of woodlands and grasslands, Escarpment Slopes, *1647*
Mikania *Willd.*
natalensis *DC.*, twining liane of forests and mesic thickets, especially below Escarpment Plateau, *898*
Aster *L.*
comptonii *Lippert*, infrequent subwoody forb of Mistbelt grasslands and woodlands, *1594*
harveyanus *Kuntze*, rare forb of Foothill woodlands, *768*
lydenburgensis *Lippert*, rare forb of Mistbelt grasslands, *1338*
sp., forb of disturbed woodlands, Foothills, includes *649, 750*
Felicia *Cass.*
rosulata *Yeo*, rare forb in rocky shrublands of Summit Peak, *2503*
Nidorella *Cass.*
auriculata *DC.*, robust herbaceous bush in moist (often marshy) grasslands and thickets, Mistbelt, *605*
sp., infrequent forb of disturbed moist grasslands, Mistbelt, includes *1249, 2322*
Conyza *Less.*
*sumatrensis *(Retz.) E.H. Walker*, widespread introduced weed of disturbance, Mistbelt and Low Country, *609*
Brachylaena *R. Br.*
discolor *DC.* subsp. transvaalensis *(Phill. & Schweick.) J. Paiva*, fairly large canopy and emergent tree in Forest and Mesic Thicket of Mistbelt and Low Country, *679*
Tarchonanthus *L.*
trilobus *DC.* var. galpinii *(Hutch. & Phill.) J. Paiva*, localized tree of rocky woodlands, Plateau Crest, *1433*
Blumea *DC.*
alata *(D. Don) DC.*, widespread herbaceous weed of disturbed woodlands and thickets, Low Country, *606*
Gnaphalium *L.*
sp., subwoody herb of retarded grasslands, Summit Plateau, *2327*
Tenrhynea *Hilliard & Burtt*
phylicifolia *(DC.) Hilliard & Burtt*, widespread shrubby forb of woodlands and grasslands, Mistbelt and Low Country, *766*
Helichrysum *Mill.*
acutatum *DC.*, common subwoody forb of Summit woodlands, shrublands and grasslands, *2357*
adenocarpum *DC.*, infrequent forb of broken lithoseral grasslands, Plateau Crest, *1179*
aureonitens *Sch. Bip.*, small herb, common in grasslands of Mistbelt, *1100*
aureum *(Houtt.) Merr.* var. monocephalum *(DC.) Hilliard*, small subwoody forb, infrequent in Mistbelt grasslands, *1242*
cephaloideum *DC.*, localized herb of Plateau Crest grasslands, *1205*
chionosphaerum *DC.*, infrequent forb in Low Open Shrubland on exposed stoney slopes, Summit, *Weisser 9036*
chrysargyrum *Moeser*, widespread, infrequent bushy forb of seral woodlands, Mistbelt and Low Country, *673*
'complex', common subwoody forb, widespread in grasslands and woodlands of Humid Mistbelt:
acutatum *DC.*, *1099*
thapsus *(Kuntze) Moeser*, *1520*
cooperi *Harv.*, localized forb of Plateau Crest woodlands, *1413*
coriaceum *Harv.*, subwoody herb, infrequent in Mistbelt grasslands, *1656*
difficile *Hilliard*, large infrequent forb bordering marshy grasslands, Summit Plateau, *2737*
edwardsii *Wild*, large forb, infrequent in Summit grasslands, *2482*
glomeratum *Klatt*, infrequent forb of Summit Plateau grasslands, *2544*
harveyanum *Wild*, infrequent forb, localized in dolomite-soil grasslands of Plateau Interior, *1303*
homilochrysum *S. Moore*, shrubby bush in sheltered ravines, Summit Slopes, *2703*
kraussii *Sch. Bip.*, shrubby ericoid forb, localized in lithoseral woodlands of Escarpment Slopes and Plateau Crest, *975*
mariepscopicum *Hilliard*, infrequent forb of Summit grasslands, *2680*
mimetes *S. Moore*, lax forb, widespread in lithoseral grasslands and woodlands of Mistbelt, *1607*
mixtum *(Kuntze) Moeser*, infrequent forb of woodlands and grasslands, Mistbelt, *1525*
nudifolium *(L.) Less.*, widespread subwoody forb of thickets, woodlands and grasslands, Mistbelt and Low Country, *618*
odoratissimum *(L.) Sweet*, widespread bushy forb of open woodlands and grasslands, especially Mistbelt, *1932*
opacum *Klatt*, rare forb of Summit grasslands, *2692*
pallidum *DC.*, subwoody herb, infrequent in lithoseral woodlands of Humid Mistbelt, *1558*
panduratum *O. Hoffm.* var. transvaalense *Moeser*, widespread forb of mesic thickets, woodlands and grasslands, especially Mistbelt, *712*
pilosellum *(L. f.) Less.*, subwoody herb, common in Mistbelt grasslands, *1164*
platypterum *DC.*, robust perennial forb, occasional in Mistbelt grasslands, *1585*
reflexum *N.E. Br.*, infrequent shrubby forb, localized in broken lithoseral woodlands of Lower Mountain Slopes, *1497*
setosum *Harv.*, rare forb of riparian woodlands, Summit Plateau, *2126*
sp., variable forb, widespread in Mistbelt grasslands and woodlands and in Low Country woodlands and thickets, includes *1157, 1253, 2299*
sp. nov. 1 *(Werdermann & Oberdieck 2179)*, infrequent subwoody herb, widely scattered in Mistbelt grasslands, especially in broken lithosere of Lower Mountain Slopes, *1493*
sp. nov. 2 *(Scheepers s.n.)*, infrequent subwoody forb of disturbed seepage thickets, Lower Mountain Slopes, *1590*
sp. nov. 3 *(Van der Schijff 4335A)*, localized forb, rare in marshy grasslands of Escarpment Plateau, *1263*
spiralepis *Hilliard & Burtt*, large forb, fairly common in grasslands of Summit Plateau, *2536*
splendidum *(Thunb.) Less.*, low dense bush invading moist fire-protected sites on Summit, *2641*
subluteum *Burtt Davy*, small forb, fairly common in grasslands of Summit Slopes and Plateau, *2393*
truncatum *Burtt Davy*, small tufted forb, infrequent in grasslands of Summit Plateau, *2562*
umbraculigerum *Less.*, lax soft subwoody forb, infrequent in woodlands and grasslands of Humid Mistbelt, *1154*
wilmsii *Moeser*, low shrubby forb, widespread in Mistbelt grasslands and woodlands, *1106*
Stoebe *L.*
vulgaris *Levyns*, scattered ericoid shrub of Summit Plateau and Slopes, *2390*
Athrixia *Ker-Gawl.*
phylicoides *DC.*, widespread shrubby forb, localized mainly in

thickets and woodlands of Transitional Mistbelt and Low Country, *645*

Inula *L.*

glomerata *Oliv. & Hiern*, robust herb, localized mainly in more exposed woodlands and xeric thickets of Low Country, *635*

Geigeria *Griesselich*

burkei *Harv.* subsp. burkei var. elata *Merxm.*, infrequent forb, widely scattered in Low Country woodlands, *842*

burkei *Harv.* subsp. burkei var. hirtella *Merxm.*, infrequent forb of rank grasslands, Mountain Slopes, *1515*

Anisopappus *Hook. & Arn.*

latifolius *(S. Moore) B.L. Burtt*, trailing forb, infrequent in Summit grasslands, *2554*

Acanthospermum *Schrank*

*australe *(Loefl.) Kuntze*, lax forb of disturbed grasslands and woodlands, especially from Plateau Crest to Upper Foothills, *596*

Bidens *L.*

kirkii *(Oliv. & Hiern) Sherff*, infrequent forb of lithoseral woodlands, Plateau Crest, *1640*

*pilosa *L.*, widespread forb, characteristic weed of disturbance, Mistbelt and Low Country

Inulanthera *Källersjö*

calva *(Hutch.) Källersjö*, herbaceous bush, localized in grasslands and rocky woodlands of Plateau Crest and Lower Mountain Slopes, *1976*

Phymaspermum *Less. emend. Källersjö*

acerosum *(DC.) Källersjö*, herbaceous bush, localized in grasslands and rocky woodlands of Escarpment and Summit (Plateau and Slopes), *1111*

Inezia *Phill.*

integrifolia *(Klatt) Phill.*, perennial herb, widespread in grasslands and rocky woodlands of Mountain Slopes and Summit, *1462*

Schistostephium *Less.*

crataegifolium *(DC.) Fenzl ex Harv.*, subwoody forb, infrequent in grasslands of Escarpment and Lower Mountain Slopes, *1530*

heptalobum *(DC.) Oliv. & Hiern*, subwoody perennial forb, widely scattered in undergrowth of forests and mesic thickets of Mistbelt, *928*

rotundifolium *(DC.) Fenzl ex Harv.*, infrequent shrub of Closed Woodland on rocky knolls, Summit Slopes, *2294*

Artemisia *L.*

afra *Jacq. ex Willd.*, shrubby herb, localized in thickets and woodlands of Mountain Slopes, *1559*

Lopholaena *DC.*

disticha *(N.E. Br.) S. Moore*, subsucculent herb, infrequent in grasslands of Escarpment Slopes, *1947*

segmentata *(Oliv.) S. Moore*, perennial herb, infrequent in grasslands of Escarpment Plateau and Lower Mountain Slopes, *1532*

Cineraria *L.*

sp., field layer herb of moist bushy ravines, Summit Slopes, *2679*

Senecio *L.*

affinis *DC.*, infrequent subwoody forb of Mistbelt grasslands, *1546*

conrathii *N.E. Br.*, infrequent subwoody forb of Mountain Slope grasslands, *1616*

coronatus *(Thunb.) Harv.*, low forb, widely scattered in open woodlands of Mistbelt and Low Country, *1511*

deltoideus *Less.*, infrequent climber in mesic thickets of Transitional Mistbelt, *920*

erubescens *Ait.* var. crepidifolius *DC.*, localized forb of Plateau Crest grasslands, *1121*

erubescens *Ait.* var. dichotomus *DC.*, infrequent forb of Humid Mistbelt grasslands, *1180*

gerrardii *Harv.*, large herb, localized in Plateau Crest grasslands, *1214*

glaberrimus *DC.*, widespread subwoody forb of grassslands and woodlands, Mistbelt and Low Country, *1274*

latifolius *DC.* (= S. sceleratus), localized forb, mainly in grasslands of Escarpment Plateau, *26*

lydenburgensis *Hutch. & Burtt Davy*, infrequent forb of Summit and Escarpment Plateau grasslands, *1314*

macrocephalus *DC.*, rosette forb, infrequent in rocky grasslands of Escarpment Slopes, *1145*

mikanioides *Otto ex Harv.*, slender liane, occasional in tall forests of Escarpment Slopes, *1142*

oxyriifolius *DC.*, small subsucculent herb, often associated with rocks. widespread in grasslands and woodlands of Mistbelt and Low Country, *1038*

panduriformis *Hilliard*, infrequent tall herb of disturbed thickets, Escarpment Slopes, *1250*

polyodon *DC.* var. polyodon, infrequent forb in moist Mistbelt grasslands, *1105*

pterophorus *DC.*, subwoody forb, infrequent in seral grasslands of Escarpment and Lower Mountain Slopes, *111*

scitus *Hutch. ex Burtt Davy*, occasional subsucculent forb of Summit grasslands and shrublands, *2635*

serratuloides *DC.* var. serratuloides, robust forb, localized in disturbed woodlands of Upper Foothills, *1828*

sp., forb of Summit grasslands, *2555*

tamoides *DC.*, succulent climber, in forests and mesic thickets of Mountain and Escarpment Slopes, *2059*

venosus *Harv.*, subwoody forb, infrequently scattered in woodlands of Escarpment Slopes and Foothills, *1545*

Euryops *Cass.*

pedunculatus *N.E. Br.*, subwoody herb, localized in lithoseral grasslands and shrublands of Mistbelt, *1637*

transvaalensis *Klatt* subsp. setilobus *(N.E. Br.) B. Nord.*, small subwoody herb, infrequent in Mistbelt grasslands, *1499*

Haplocarpha *Less.*

scaposa *Harv.*, low perennial herb, widespread in woodlands, shrublands and grasslands of Mistbelt and Low Country, *669*

Berkheya *Ehrh.*

echinacea *(Harv.) O. Hoffm. ex Burtt Davy* subsp. echinacea, infrequent forb, widespread in Low Country woodlands and Mistbelt grasslands and shrublands, *769*

insignis *(Harv.) Thell.*, small forb, widespread in woodlands, shrublands and grasslands of Mistbelt and Low Country, *641*

latifolia *Wood & Evans*, infrequent forb of Plateau Crest open woodlands, *1980*

radula *(Harv.) De Wild.*, large forb associated with wooded knolls, Summit, *2302*

setifera *DC.*, infrequent forb of Low Country woodlands, *1823*

sp., variable forb in undergrowth of mesic thickets, Escarpment Lower Slopes, includes *1075*

Dicoma *Cass.*

anomala *Sond.* subsp. cirsioides *(Harv.) Wild*, perennial forb, infrequent in Summit and Mountain Slopes grasslands, *1459*

zeyheri *Sond.*, perennial forb, widespread in woodlands and grasslands of Mistbelt and Low Country, *636*

Gerbera *L.*

ambigua *(Cass.) Sch. Bip.*, widespread rosette forb of Plateau Crest and Summit grasslands and woodlands, *Weisser 9031*

aurantiaca *Sch. Bip.*, rosette forb, widespread in woodlands and grasslands of Mistbelt and Low Country, *656*

jamesonii *H. Bol. ex Adlam*, rosette forb, mainly localized in Woodland and Xeric Thicket of Low Country, *84*

piloselloides *(L.) Cass.*, occasional rosette forb of Mistbelt grasslands, *1333*

viridifolia *(DC.) Sch. Bip.* subsp. viridifolia, small rosette forb, infrequent in Low Country woodlands, *1743*

Tolpis *Adans.*

capensis *(L.) Sch. Bip.*, rosette forb, localized in Plateau Crest and Summit grasslands, *1210*

Hypochoeris *L.*

*microcephala *(Sch. Bip.) Cabrera* var. albiflora *(Kuntze) Cabrera*, rare rosette forb of dolomite-soil grasslands, Plateau Interior, *1367*

*radicata *L.*, infrequent weed of disturbed rank grasslands, Summit Plateau, *2642*

Sonchus *L.*

integrifolius *Harv.*, small herb with milky latex, localized in dolomite-soil grasslands of Plateau Interior, *1325*

sp., infrequent herb on termitaria, grasslands of Lower Mountain Slopes, *1543*

wilmsii *R.E. Fries*, herb with milky latex, infrequent in Mistbelt grasslands, *1537*

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A survey and analysis of traditional medicinal plants as used by the Zulu, Xhosa and Sotho

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Keywords: ailment, medicinal plants, Sotho, Xhosa, Zulu

ABSTRACT

A coded list of 794 traditional Zulu medicinal plants is presented with a key to the ailments concerned. Xhosa and Sotho usage of these plants is incorporated. Medicinal usage in the pteridophytes, gymnosperms, monocotyledons and dicotyledons is tabulated. Ailments are categorized and discussed with an analysis of the plant families involved in their treatment. Patterns of usage between related plants are observed and some potentially effective or dangerous characteristic family constituents are briefly outlined.

UITTREKSEL

'n Gekodeerde lys van 794 tradisionele medisinale plante van die Zoeloes word aangebied met 'n sleutel tot die betrokke ongesteldhede. Die gebruik van hierdie plante deur Xhosas en Sotho's word ook vermeld. Benutting van die pteridofiete, gimnosperms, monokotiele en dikotiele is getabuleer. Ongesteldhede word gekategoriseer en bespreek met 'n ontleding van die plantfamilies wat by die behandeling betrokke is. Benuttingspatrone tussen verwante plante is waargeneem en sekere potensieel doeltreffende of gevaarlike stowwe wat kenmerkend in families voorkom, word kortliks aangetoon.

INTRODUCTION

The data on which this paper is based come mainly from a literature survey conducted by the author towards the compilation of a Pharmacapoeia of Zulu Folk Medicine, which was initiated at the University of Zululand by Dr A. H. Scott in 1986. Xhosa and Sotho usage of the plants, which is closely allied, has been included. Data from the author's previous fieldwork in Transkei and limited personal interviews with Zulu and Xhosa traditional healers is included and further data have been abstracted from a list of the Botanical Research Institute's holdings of medicinal plants. The main sources of information on usage have been 1, A. T. Bryant, whose work on Zulu medicine was originally published in the *Annals of the Natal Museum* in 1909 but later destroyed by fire and republished in 1966 (Bryant 1966); 2, J. Gerstner, who published his work on Zulu plant names and usage between 1938 and 1941 (Gerstner 1938, 1939, 1941); and 3, Mairn Hulme, who included Zulu usage and also illustrated her book (Hulme 1954). Watt & Breyer-Brandwijk (1962) was also consulted and additional information on Sotho usage is from A. Jacot Guillarmod (Jacot Guillarmod 1971).

It would be of great interest to compare the number of plant species used with the number of plant species known to be available, but research in this field, embracing both ecological and trading aspects, is beyond the scope of this paper. Comprehensive research into the toxicity and active chemical principles in the plants used is also beyond the scope of the paper.

DISCUSSION OF LIST OF MEDICINAL PLANTS

A total number of 794 plant species with specific usage known has been recorded. These are grouped as pteridopytes, gymnosperms, monocotyledons and dicotyledons. They are arranged in alphabetic order according to family and within the family alphabetically according to genus and species. All plant names used in the literature surveyed have been recorded and the names listed have been updated according to Gibbs Russell *et al.* (1985, 1987). Authors' names have been omitted from the coded list to save space so that uses could be tabulated and similarities in the usage of related species could be easily seen.

Plants of the same genus which could not be identified to species level have been counted as one species unless, as in the case of the *Plectranthus* spp. illustrated by Hulme (1954), it is quite evident that different species are being referred to.

The species listed have been coded according to ailment. These ailments have been very broadly categorized and determined largely by symptom, as is traditional treatment. Overlaps occur, as in the case of bladder and urethral disorders, which have been classed by the author as a common renal ailment but could be caused or affected by procreation-related ailments such as sterility and venereal disease.

The presence of a known or suspected toxic element recorded in the literature surveyed is indicated by an asterisk in the coded list at the end of this article. The toxic element may not always be known in the part of the plant used.

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Key to ailments:

A — Sexual	a — Includes use as anthelmintic
B — Sterility	c — Includes enema administration
C — Venereal	d — Includes use against diarrhoea
D — Gynaecological	e — Includes use as an emetic
E — Newly born infants	i — Given to infants or children
F — Gastro-intestinal	p — Taken regularly during pregnancy
G — Renal	r — Rubbed into scarifications
H — Tonic	s — Snuffed or inhaled
I — Growths	* — Toxic
J — Respiratory	
K — Febrile	
L — Headaches	
M — Heart	
N — Nervous	
O — Pain producing	
P — Leprosy	
Q — Dental	
R — Sorcery	
S — Snake-bite	
T — Skin	
U — Sprains, fractures	
V — Eyes, ears and nose	
W — Insecticidal	
X — Charm	
Y — Animal	

ANALYSIS

In this analysis of ailments and methods of treatment, families, of which three or more species are used for the same ailment, are highlighted.

Families marked with an asterisk are those of which one or more species used for the specific ailment have been recorded as toxic.

Procreation-related ailments (A–E in key to ailments and coded list of plants)

A. *Sexual* remedies include aphrodisiacs and a large number of love charm emetics, which are normally taken by men. Some medicines are administered as charms to secure the fidelity of the beloved or to harm a rival in cases of suspected infidelity or to protect the user against the effects of such medicine.

Of the 109 species recorded as sexual remedies, three or more occur in the following 12 families, accounting for 79:

13 Orchidaceae	4 Gentianaceae
13 Fabaceae*	4 Scrophulariaceae
11 Liliaceae*	4 Acanthaceae
7 Rubiaceae	4 Asteraceae*
5 Euphorbiaceae*	3 Amaryllidaceae*
4 Apiaceae	3 Caryophyllaceae
4 Acanthaceae	

95 of the 109 species are used as love charm emetics.

B. *Sterility* remedies include cures for both women and men. Barrenness in women is usually treated with a purgative or an enema or medicine may be directly introduced into the womb. Sterility and impotence in men is treated with orally taken infusions, or powdered medicines may be blown through the urethra (Bryant 1966). Also included are medicines taken, usually orally, by a couple desiring a particular gender in a child, or medicines taken by both parents after a miscarriage.

Of the 45 species recorded as sterility remedies, three or more occur in the following six families, accounting for 25:

7 Orchidaceae	3 Liliaceae*
4 Iridaceae*	3 Amaryllidaceae
5 Fabaceae	3 Rubiaceae

C. *Venereal diseases* (syphilis and gonorrhoea) may be treated with orally administered decoctions or, in cases of discharge, medicine may be inserted directly into the penis or vagina in liquid form or as a pill of pounded leaves, and charred powdered leaves or a poultice may be applied directly to venereal sores (Bryant 1966).

Of the 34 species recorded as venereal disease remedies, three or more occur in the following five families, accounting for 19:

6 Liliaceae*	3 Fabaceae*
4 Asteraceae	3 Solanaceae*
3 Ranunculaceae*	

D. *Gynaecological* remedies include medicines taken regularly during pregnancy to ensure a safe delivery and a healthy child. These may be mixtures of various ingredients, usually roots (Gerstner 1941) or may be made from the roots of a single plant, soaked in water, which is drunk daily by the expectant mother. Also included are medicines administered during childbirth, or for painful or delayed menstruation, to stimulate breast development or the flow of milk, or to procure abortions.

Of the 78 species recorded, three or more occur in the following six families, accounting for 37:

12 Liliaceae*	4 Ebenaceae*
10 Asteraceae*	4 Scrophulariaceae
4 Amaryllidaceae*	3 Euphorbiaceae*

Of the 78 species used for gynaecological purposes, 38 are recorded as taken regularly during pregnancy, three or more of which occur in the following three families, accounting for 16:

8 Liliaceae*	3 Amaryllidaceae*
5 Asteraceae*	

E. *Newly-born infants* are sometimes given purification purges at birth and later at weaning; these may be administered orally or as an enema. Medicines may be applied to the navel or fontanel at birth and others may be applied to the mother's breast at weaning. Sometimes newly born infants are held in the smoke of a burning plant in a protective or purification ritual.

Of the 18 species recorded, seven occur in Liliaceae.

Stress-related ailments (L–O in key and coded list of plants)

(*Note*—the term stress-related is used here to refer to ailments that are caused by psychological stress, although there may be other causes.)

L. *Headaches* are considered by traditional healers to be caused by emotional or mental disturbance. They are often treated by snuffed or inhaled medicines and occasionally leaves are wrapped around the head.

Of the 44 species recorded, three or more come from the following five families, acounting for 22:

6 Euphorbiaceae*	3 Fabaceae*
6 Asteraceae*	3 Asclepiadaceae*
4 Ranunculaceae*	

M. *Cardiac* ailments include high blood pressure, chest pain not associated with respiratory complaints and bad dreams believed to be caused by heart problems (Bryant

1966). Treatment may be administered in the form of an emetic or enema.

Of the 21 species recorded, three occur in the following two families, accounting for six:

3 Liliaceae*	3 Fabaceae*

N. *Nervous* or psychological ailments include hysteria, mental disturbance, nightmares, states of believed bewitchment, states of impurification after the death of a kraal member and states of trance which need to be induced in the diviner to enable her to fulfil her function. Emetics and snuffed or inhaled medicines are frequently used for these purposes.

Of the 133 species recorded for nervous ailments, three or more come from the following 12 families, accounting for 81:

16 Fabaceae*	5 Iridaceae*
12 Asteraceae*	4 Euphorbiaceae*
8 Liliaceae*	4 Apiaceae
8 Rubiaceae	3 Hypoxidaceae*
7 Orchidaceae	3 Sapindaceae
8 Asclepiadaceae*	3 Solanaceae*

O. *Pain producing* ailments include pain in the joints or back, rheumatism and also paralysis. Although these may obviously not always have a psychological cause, there is a traditional belief that the joints are the most vulnerable area to the entrance of evil spirits (Ngubane 1977) and conversion disorders often do take the form of pain in the joints and sometimes paralysis. Dried powdered medicine is frequently rubbed into freshly cut scarifications to treat these conditions and other forms of administration such as enemas and emetics are also used.

Of the 46 species recorded, three or more come from the following families, accounting for 13:

7 Liliaceae*	3 Meliaceae*
3 Fabaceae*	

Miscellaneous ailments (F–K and Q–Y in key and coded list of plants)

F. *Gastro-intestinal* ailments include:

1, stomach ache and constipation, which are treated with enemas or orally administered purges;

2, intestinal worms which are treated with orally administered anthelmintics or enemas;

3, diarrhoea and dysentery which are treated with an orally administered medicine, frequently followed by an enema of the same medicine;

4, nausea or the accumulation of bile is treated with an emetic;

5, indigestion, for which small pieces of root, bark or leaves may be chewed;

6, haemorrhoids and a condition which Bryant (1966) and Ngubane (1977) refer to as gangrenous rectitis, which is frequently treated with an enema, or a locally applied lotion or powder and may also be treated with an orally taken decoction.

Of the 318 species recorded for gastro-intestinal complaints, three or more occur in the following 35 families, accounting for 252:

40 Asteraceae*	4 Poaceae
27 Liliaceae*	4 Cyperaceae
19 Fabaceae*	4 Amaryllidaceae*
12 Rubiaceae	4 Polygonaceae
13 Euphorbiaceae*	4 Amaranthaceae
11 Iridaceae*	4 Mesembryanthemaceae
8 Lamiaceae	4 Rosaceae
7 Crassulaceae*	4 Geraniaceae
7 Asclepiadaceae*	4 Meliaceae*
7 Convolvulaceae	4 Anacardiaceae*
7 Cucurbitaceae*	4 Scrophulariaceae
6 Ebenaceae*	3 Aspidiaceae*
6 Celastraceae*	3 Ranunculaceae
5 Apiaceae	3 Rutaceae
5 Myrsinaceae*	3 Sapindaceae*
5 Verbenaceae	3 Gentianaceae
5 Solanaceae*	3 Apocynaceae*

Of the 318 species recorded as gastro-intestinal remedies 46 are recorded as anthelmintics and 54 as diarrhoea and dysentery remedies. These species may also be used for other gastro-intestinal purposes.

Of the 46 recorded anthelmintics, three or more occur in the following four families, accounting for 22:

8 Asteraceae*	4 Myrsinaceae*
7 Liliaceae*	3 Aspidiaceae*

Of the 54 recorded diarrhoea and dysentery remedies, three or more occur in the following six families, accounting for 30:

10 Fabaceae*	3 Sapindaceae*
7 Iridaceae*	3 Rubiaceae
4 Geraniaceae	3 Asteraceae

G. *Renal* ailments include kidney and urinary tract complaints. Medicines may be orally administered, sometimes followed by an enema of the same medicine after three days of treatment, or medicines may be rubbed into incisions cut in the loins or inserted directly into the urethra or a poultice may be applied externally.

Of the 44 species recorded for renal ailments, three or more are found in the following five families, accounting for 19:

5 Amaryllidaceae*	3 Apocynaceae*
5 Asteraceae*	3 Euphorbiaceae*
3 Liliaceae*	

H. *Debility* ailments include general weakness, a low resistance to infections, blood impurities and a lack of appetite. They are treated with orally taken tonics, emetics or enemas.

Of the 58 species recorded for debility, three or more come from the following six families, accounting for 24:

8 Asteraceae	3 Apocynaceae*
4 Euphorbiaceae*	3 Periplocaceae
3 Fabaceae	3 Rubiaceae

I. *Swellings or growths* include swollen glands, scrofulous and dropsical swellings and external or internal swellings or lumps which may or may not be cancerous. Medicines may be administered orally, sometimes followed by a poultice made from the same ingredients, or powdered medicines may be rubbed into incisions cut around the swelling.

Of the 31 species used to treat swellings, three or more come from the following two families, accounting for eight:

5 Euphorbiaceae*	3 Asteraceae*

J. *Respiratory* ailments include chest pain from pleurisy or bronchitis, coughs, sore throats and asthma or catarrh. They are frequently treated with emetics, which perform an expectorant function, or medicines may be chewed, drunk, snuffed, inhaled or rubbed into incisions on the chest.

Of the 144 species recorded for respiratory ailments, three or more come from the following 14 families, accounting for 92:

27 Asteraceae*	5 Verbenaceae
12 Fabaceae*	4 Rubiaceae
8 Euphorbiaceae*	3 Phytolaccaceae*
6 Liliaceae*	3 Brassicaceae
5 Amaryllidaceae*	3 Capparaceae*
5 Apiaceae*	3 Ebenaceae*
5 Lamiaceae	3 Celastraceae*

K. *Febrile* complaints include influenza, colds and fevers, including malaria and rheumatic fever. They are frequently treated with emetics. Snuffed or inhaled medicines may also be administered and the patient may be steamed or bathed to reduce the fever.

Of the 123 species involved, three or more come from the following 13 families, accounting for 82:

21 Asteraceae*	3 Iridaceae*
12 Fabaceae	3 Rutaceae
10 Lamiaceae	3 Amaranthaceae
6 Liliaceae*	3 Apiaceae
6 Euphorbiaceae*	3 Scrophulariaceae
5 Rubiaceae	3 Lobeliaceae
4 Amaryllidaceae*	

P. *Leprosy* is usually now referred by traditional healers to the hospitals. Only two remedies have been recorded and they are from Melianthaceae and Passifloraceae.

Q. *Toothache* and sore gums are treated with lotions or powders rubbed on to the painful area.

Of the 30 species recorded for toothache, three or more are from the following three families, accounting for 12:

5 Solanaceae*	3 Euphorbiaceae*
4 Asteraceae*	

R. *Sorcery* is believed to be the cause of many illnesses and certain plants are believed to be used by sorcerers to bring about evil. The same plants may be taken as an antidote to the disease thus brought about, usually in the form of an emetic.

Of the 16 species recorded as sorcerer's medicines, three each are from the following two families, accounting for six:

3 Euphorbiaceae*	3 Apiaceae*

S. *Snake bite* remedies may be taken or locally applied, the same medicine often being administered at the same time in both forms. Dried ground snakes' heads are sometimes an ingredient in the medicine.

Of the 43 species recorded, three or more come from the following six families, accounting for 20:

4 Thymelaeaceae*	3 Fabaceae*
4 Asteraceae*	3 Euphorbiaceae*
3 Phytolaccaceae*	3 Apocynaceae*

T. *Skin* complaints include sores, wounds, burns and rashes. These complaints may be treated by applied lotions, poultices or washes. Washes may also be given to reduce the temperature in fevers. Also included are hair restorers.

Of the 100 species recorded, three or more come from the following 10 families, accounting for 64:

15 Asteraceae*	4 Amaryllidaceae*
11 Fabaceae*	4 Thymelaeaceae
9 Solanaceae*	4 Acanthaceae
7 Euphorbiaceae*	3 Verbenaceae
4 Liliaceae*	3 Lamiaceae

U. *Fractures, sprains and bruises* may be treated with lotions, or powder may be rubbed into scarifications as an anti-inflammant around the site of the damage.

Of the 40 species recorded, three or more come from the following three families, accounting for 12:

6 Asteraceae*	3 Crassulaceae*
3 Euphorbiaceae*	

V. *Ear, eye and nose* complaints are treated with lotions or sap directly squeezed from the plants.

Of the 39 species recorded, three or more come from the following four families, accounting for 19:

7 Liliaceae*	3 Crassulaceae*
6 Asteraceae	3 Rosaceae

W. *Insecticides and piscicides* include medicines applied to rid the body of lice and fleas and those used to repel or kill flies and those used to stun fish so that they may be caught.

Of the 21 species recorded, three or more come from the following two families, accounting for 12:

9 Fabaceae*	3 Asteraceae

X. *Charms* may be applied to placate evil spirits, for protection against enemies and storms, for good luck or to make the user liked. They may be bathed with, worn, sprinkled or burnt in the home or fields or cultivated as protective plants.

Of the 182 species recorded, three or more come from the following 14 families, accounting for 126:

27 Liliaceae*	7 Fabaceae*
18 Orchidaceae	7 Euphorbiaceae*
15 Asclepiadaceae*	6 Apiaceae
11 Asteraceae*	3 Rhamnaceae
9 Amaryllidaceae*	3 Scrophulariaceae
9 Crassulaceae*	3 Rubiaceae
8 Iridaceae*	

Y. *Animals* may be given medicines to prevent or cure disease. Also included are medicines applied as theft deterrents, either in the field or on eggs or drying animal skins.

Of the 102 species used to treat or deter animals, three or more come from the following 11 families, accounting for 53:

11 Asteraceae*	3 Amaryllidaceae*
9 Fabaceae*	3 Dioscoreaceae*
7 Liliaceae*	3 Urticaceae
6 Asclepiadaceae*	3 Geraniaceae
5 Lamiaceae	3 Vitaceae*

It may be observed (Table 1) that among the medicinally used plants recorded, a higher proportion of monocotyledons are used as externally applied charms and for procreation-related purposes and that there is a slightly wider range of medicinal usage among the dicotyledons. Further analysis reveals that among the mono-

cotyledons 43 % of the species are used for procreation-related ailments, 37 % as externally applied charms and 26 % for possibly stress-related ailments whereas among the dicotyledons 27 % are used for procreation-related ailments, 26 % for possibly stress-related ailments and 19 % as externally applied charms. In both groups the greatest proportion of plants used for other ailments are used for gastro-intestinal purposes (32 % of monocotyledons and 42 % of dicotyledons) and respiratory ailments (11 % of monocotyledons and 20 % of dicotyledons). This is reflected in Tables 2 & 3.

DISCUSSION

Perception of aetiology also determines treatment. According to Bryant (1966) and Ngubane (1977), most common ailments are believed to be caused by an excess of bile or gall, which needs to be removed. Diseases believed to be caused by evil spirits or pollution also require catharsis. This explains the wide use of emetics, enemas and purgatives. A total of 238 of the plants recorded for this study, i.e. 30 %, are used as emetics—where use as an emetic has been recorded with no specific ailment, the plant has been considered to be used for gastro-intestinal purposes. Emetics are not normally given to young children but enemas are and are considered by medical staff to be the cause of some of the poisoning cases and liver damage seen in hospitals (Savage & Hutchings 1987). Forms of administration are not always recorded in the sources consulted and more plants are probably used for enemas than appear on the list. Species indicated as being used for children are frequently administered in this way. Patterns of usage between closely related species, such as the use of pteridophytes as anthelmintics, Orchidaceae as love charm emetics, Ranunculaceae species for headaches, Thymelaeaceae species for skin complaints and snake bite or Lamiaceae for febrile conditions and various Asclepiadaceae for nervous complaints, are discernible in the list.

Such patterns of usage could obviously indicate that related plants share chemical constituents, which would in turn account for their possible effectiveness and/or toxicity. Some characteristic family constituents with some of their likely effects and potential dangers are given below.

Widespread steroidal saponins, cardiac glycosides in some of the Liliaceae and toxic alkaloids in the Amaryllidaceae are among the potentially dangerous consituents found in monocotyledonous plants, of which so many are used in the procreation-related ailments. Steroidal saponins may affect the sex hormones and are relatively harmless when taken by mouth but found highly toxic if they enter the blood stream (Trease & Evans 1983). This may happen if there is any damage to the mucous lining of the gastro-intestinal tract when enemas are administered as, according to Ngubane (1977), the dosage is controlled to enable the patient to retain the medicine for a time. This custom would also make enemas made with other toxic material more dangerous than emetics as absorption of material through the rectum is easier than through the small intestine. Steroid or triterpenoid saponins (which are common in the dicotyledons) are often found in the plants used as emetics and have the property of foaming and also frequently irritate the mucosa. This may account for their expectorant and decongestive action when used for chest ailments. Anti-microbial, cytostatic and anti-inflammatory activity have been demonstrated in saponins (Lower 1985).

Cardiotonics, which can have a diuretic action by increasing the renal bloodflow, may be found in members of various other families apart from Liliaceae and these include Apocynaceae and Asclepiadaceae, Rubiaceae and Solanaceae (see Oliver-Bever 1986). The diuretic action would be helpful in cases of gonorrhoea and also in various kidney or heart diseases which cause dropsical swellings. Various species of the above-mentioned families are used for venereal diseases, renal complaints, dropsical swellings or heart complaints and may be found effective.

The toxic Amaryllidaceae alkaloids produce gastro-intestinal upset (Jaspherson–Schib 1970). Highly toxic species are found in other alkaloid-containing families such as Apocynaceae, Solanaceae and Euphorbiaceae. These species also owe their effectiveness as purges and their potentially dangerous properties to extreme gastric irritation.

Antipyretic, protozoicidal and local anaesthetic properties are to be found in many of the West African species of the alkaloid-rich Rubiaceae family (Oliver-Bever 1986) and members of the family locally used for febrile ailments would probably merit further investigation. Alkaloids have a marked action on the central nervous system and can act as depressants (e.g. the sedative reserpine from *Rauvolfia vomitoria* Afzel.) or stimulants (e.g. the *Strychnos* alkaloids) which may account for the use of various species from families such as Euphorbiaceae and Solanaceae for nervous complaints.

Tannin has frequently been observed in the parts of the plant used in the treatment of dysentery and diarrhoea or for respiratory ailments and is a characteristic constituent of many of the families thus used (e.g. Rosaceae, Fabaceae, Geraniaceae). It is likely to be effective on account of its protein-precipitating properties which, in small doses, would form a protective, impermeable layer and also tend to prevent the development of bacteria—large doses would irritate the mucosa (Flück 1976).

The presence of volatile oils with possible carminative or antispasmodic activity is likely to account for the use of the closely related Lamiaceae and Verbenaceae and other aromatic families for coughs, colds, influenza and digestive disorders.

The snake bite cures are interesting. Many are known to be either toxic or else closely related to known toxic species, notably from families where cardioactive toxins (Melianthaceae, Loganiaceae, Apocynaceae and Asclepiadaceae) or alkaloids (Phytolaccaceae, Solanaceae and Asteraceae) are known or else from families where cytotoxic activity has been observed (Euphorbiaceae and Thymelaeaceae).

More fieldwork will undoubtedly reveal new usage of plants as the practice of herbal medicine is still very much alive. Patterns obviously exist in the usage of plants, but the perception thereof is influenced by the way in which the data are analysed and on the cultural

TABLE 1.—Medicinal usage in pteridophytes, gymnosperms, monocotyledons and dicotyledons

Group	Gen.	Spp.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
Pterid.	7	9		1		3		6				2	3	1		1			1			1					2
Gymnosp.	2	3	1					1						1												2	
Monocot.	79	173	30	21	7	25	10	56	9	2	3	19	17	5	5	30	9				1	12	6	8	1	65	17
Dicot.	345	609	78	23	28	50	12	255	35	56	28	123	103	37	16	102	37	2	31	16	43	87	34	30	20	115	83
Total	433	794	109	45	35	78	22	318	44	58	31	144	123	44	21	133	46	2	32	16	44	100	40	38	21	182	102

A–Y: see key to list of medicinal plants.

TABLE 2.—Monocotyledons: families with more than 10 medicinally used species

	No. spp.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
Liliaceae	60	11	3	7	12	7	27	3		1	6	6	2	3	9	7			1		4	1	7	1	27	7
Amaryllidaceae	22	3	3		4		4	5		2	5	4	2		2	1				1	4	1			9	3
Iridaceae	25	1	4		2	3	11				2	3			5							2			8	2
Orchidaceae	34	13	7		2		2								7	1									18	
Total	141	28	17	7	20	10	44	8		3	13	13	4	3	23	9			1	1	8	4	7	1	62	12

A–Y: see key to list of medicinal plants.

TABLE 3.—Dicotyledons: families with more than 10 medicinally used species

	No. spp.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
Crassulaceae	14	1		1	1		7					1			1			1			1	3	3		9	
Fabaceae	74	13	5	3			19	2	3		12	12	3	3	16	3		1	1	3	11	1	2	10	7	9
Euphorbiaceae	31	5			3	1	13	3	4	5	8	6	6		4	2		3	3	3	7	3	2	1	7	5
Apiaceae	11	4					5			1	5	3	1		4				3						6	1
Asclepiadaceae	28	1	1		2	2	7		1		1		3	1	8	2				1		2	1		15	6
Verbenaceae	10				1		5	2		2	5	2			2	1				2	3		2			1
Lamiaceae	21	2				1	8	1	2		5	10	2					2		2	3			1	1	5
Solanaceae	15		1	3			5	1		2	2	1	2		3	2		5		2	9	2	1			2
Scrophulariaceae	12	4		1	4		4				1	3			2	1					2	1	1		4	
Acanthaceae	12	4				1	1		1		1				2			2		2	4		2		2	1
Rubiaceae	23	7	3	1	2	1	12		3	1	4	5		2	8	1		1		1	2	1			3	
Asteraceae	80	4	2	3	10		40	4	8	3	27	21	6	2	12	2		4	2	4	15	6	7	3	10	11
Total	331	45	12	12	23	6	126	13	22	14	71	64	23	8	62	14		19	9	20	57	19	21	14	64	41

A–Y: see key to list of medicinal plants.

perceptions of the researcher. Nevertheless, plant usage is patterned, and these patterns deserve further investigation.

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LIST OF ZULU MEDICINAL PLANTS

Key to ailments:

A - Sexual
B - Sterility
C - Venereal
D - Gynaecological
E - Newly born infants
F - Gastro-intestinal
G - Renal
H - Tonic
I - Growths
J - Respiratory
K - Febrile
L - Headaches
M - Heart
N - Nervous
O - Pain producing
P - Leprosy
Q - Dental
R - Sorcery
S - Snake-bite
T - Skin
U - Sprains, fractures
V - Eyes, ears and nose
W - Insecticidal
X - Charm
Y - Animal

a - Includes use as anthelmintic
c - Includes enema administration
d - Includes use against diarrhoea
e - Includes use as an emetic
i - Given to infants or children
p - Taken regularly during pregnancy
r - Rubbed into scarifications
s - Snuffed or inhaled

* - Toxic

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
PTERIDOPHYTA																									
ADIANTACEAE																									
Adiantum capillus-veneris				D						J	K	Ls													
Cheilanthes hirta						Fa				J	K														
Cheilanthes viridis																				T					
ASPIDIACEAE																									
Dryopteris athamantica*						Fa																			y
Dryopteris inaequalis						Fa								Ns											
Polystichum sp.						Fa																			y
CYATHEACEAE																									
Cythea dregei				Dp																					
DENNSTAEDTIACEAE																									
Pteridium aquilinum*				D		Fa																			
EQUISETACEAE																									
Equisetum ramosissimum*		B				Fi					K						Q							X	
GYMNOSPERMAE																									
STANGERIACEAE																									
Stangeria eriopus						Fe						Ls												X	
ZAMIACEAE																									
Encephalartos altensteinii*	Ae																								
Encephalartos villosus*																								X	
ANGIOSPERMAE - MONOCOTYLEDONAE																									
AMARYLLIDACEAE																									
Ammocharis coranica*														N											Y
Apodolirion sp.						Fc																			
Boophane disticha*							G			Jec		Lec		N	Oec					T					
Brunsvigia spp.*		B		D		Fi	Gc			J	K									T				X	
Clivia miniata*		B		Dp			G				K								S	T					
Clivia nobilis*																								X	
Clivia sp.	Ae																							X	
Crinum bulbispermum				Dp							K													X	
Crinum delagoense																									Y
Crinum macowanii																				T					
Crinum moorei																									y
Crinum sp.							G	H	I		K														
Cyrtanthus breviflorus	Ae																							X	
Cyrtanthus contractus																								X	
Cyrtanthus mackenii																								X	
Cyrtanthus obliquus		B					Gc		I	J		Ls									Ur				
Cyrtanthus stenanthus																								X	
Cyrtanthus tuckii																								X	
Haemanthus albiflos										J															
Haemanthus coccineus*						Fe																			
Scadoxus multiflorus*	Ae																								
Scadoxus puniceus*				Dp		Fe				Jp															
ARACEAE																									
Acorus calamus*						F																			
Colocasia antiquorum*						Fc																			
Stylochiton natalense										J												V			
Zantedeschia albomaculata*				D										Nr											
ARECACEAE																									
Phoenix reclinata										Jr															
COMMELINACEAE																									
Commelina africana		B											M	N						T					
Cyanotis speciosa	A																								
CYPERACEAE																									
Cyperus esculentus				D		F																			
Cyperus longus*						Fi					Ks											Vs			

Cyperus sexangularis						Fi																		
Cyperus sp.		B				F																		
DIOSCOREACEAE																								
Dioscorea diversifolia														N										
Dioscorea dregeana				Dp										N					T					
Dioscorea dumentorum*																								Y
Dioscorea rupicola																								Y
Dioscorea sylvatica*																								Y
HYPOXIDACEAE																								
Empodium plicatum										J				N										
Hypoxis gerrardii						Fd																		
Hypoxis latifolia*	AeB						G						MeNe											
Hypoxis rooperi												L												
Hypoxis sp.						Fa								N					T					
IRIDACEAE																								
Aristea cognata																				U				
Aristea ecklonii										Jc	Kc													
Aristea woodii																							X	
Belamcanda chinensis														N										
Belamcanda sp.						F																		
Crocosmia aurea						Fd																		
Crocosmia paniculata		B				Fdc																		
Crocosmia pottsii		B				Fdc																		
Dierama pendulum																							X	
Dietes iridioides				D		Fdc																		Y
Gladiolus aurantiacus											Ke													
Gladiolus dalenii*	Ae					Fd					Ks			Ne										
Gladiolus papilio														Ne										
Gladiolus sericeo-villosus		Bc		Dc		Fdc														U			X	
Gladiolus spp.					E																		X	
Hesperantha baurii										Je													X	
Hesperantha lactea						F																		
Hesperantha sp.						F																		
Moraea sp.						Fdc																		
Moraea spathulata*		B												N										
Sparaxis grandiflora														N									X	
Tritonia disticha					E																			
Tritonia lineata					ErFi																			
Tritonia sp.																							X	
Watsonia densiflora																							X	Y
LILIACEAE																								
Agapanthus africanus*	Ae			DpE						Je			MeNe										X	
Agapanthus praecox	A			D																			X	
Albuca spp.*			C			Fa																	X	
Aloe arborescens				D																			X	Y
Aloe candelabrum					E	Fi																		
Aloe cooperi				Dp																				Y
Aloe ferox																			T		V			
Aloe gracilis																							X	
Aloe maculata						Fc					Kic													Y
Aloe marlothii					E	Fia																		
Aloe sessiliflora					E	Fi																		
Aloe sp.		B		D																	V			
Aloe spectabilis					E	Fi																		
Aloe tenuior						Fa																	X	
Aloe thraskii					E	Fi																		
Behnia reticulata	Ae																							
Bowiea volubilis*	Ae			Dp		F	G					L							T		V		X	
Bulbine alooides			C												O									
Bulbine frutescens														Ne										
Bulbine latifolia			Cc			FdG								N					T					
Bulbine sp.						F																		
Chlorophytum modestum*																							X	
Dipcadi brevifolium*													M										X	
Dipcadi sp.																							X	
Dipcadi viride			C																				X	
Drimia robusta*											Kc													
Drimiopsis maculata						Fi																		
Eriospermum mackenii																							X	
Eriospermum sp.*		B				Fe																	X	
Eucomis autumnalis*			C	Dp		FiG				JeKec					Oc								X	
Eucomis comosa															O	Qic								
Eucomis sp.						F									O	Q								
Gasteria croucheri														N									X	
Gloriosa superba*	AeB													Ne								W		
Haworthia limifolia						F																	X	
Kniphofia buchananii																							X	
Kniphofia laxiflora										J														
Kniphofia parviflora																							X	
Kniphofia rooperi										J													X	
Kniphofia uvaria				Dc																				
Ledebouria cooperi				Dp		Fi								N										Y
Ledebouria ovatifolia*				Dc		Fdc					K				O									
Littonia modesta*	Ae													Ne										
Myrsiphyllum asparagoides	Ae																				V			
Ornithogalum longibracteatum*																							X	
Protasparagus sp.										J														
Protasparagus virgatus	Ae		C			Fa																		
Sandersonia aurantiaca*	Ae																						X	
Sansevieria hyacinthoides						Fa								N							V		X	
Scilla natalensis*				Dp		Fi			Ic						O		R			U				Y
Scilla nervosa*						Fi					K													Y
Smilax kraussiana																					Vs			
Trachyandra gerrardii					Er														Ti					
Tulbaghia alliacea	A					F					K				O								X	
Tulbaghia natalensis																							X	
Tulbaghia violacea	Ae					Fc						L											X	
Urginea altissima*						Fc				J			Me								V		X	
Urginea delagoensis*																							X	
Urginea macrocentra*						Fa																		
Urginea physodes*				Dp																				Y
ORCHIDACEAE																								
Acrolophia cochlearis	Ae																							
Ansellia gigantea	Ae													Ns									X	
Brachycorythis ovata														N									X	
Brachycorythis sp.																							X	
Corycium nigrescens														Ne										
Cyrtorchis arcuata	Ae																							
Disa aconitoides		Be																						
Disa polygonoides														N										
Disa stachyoides																							X	
Disa versicolor																							X	
Eulophia angolensis	Ae																							
Eulophia clavicornis 1		B		Dp																			X	
Eulophia clavicornis 2																							X	
Eulophia clavicornis 3		B																					X	
Eulophia cucullalata	AeB																							
Eulophia ensata	Ae																							
Eulophia leontoglossa																							X	
Eulophia ovalis	AeB														Or								X	
Eulophia petersii																							X	
Eulophia sp.														Ne									X	
Eulophia speciosa																							X	
Eulophia tenella		B		Dp										Nc									X	
Eulophia welwitschii	Ae																							
Habenaria dives																	R							
Habenaria dregeana																							X	
Habenaria epipactidea						Fe								Nr									X	
Habenaria sp.		B																						
Mystacidium millarii	Ae																							
Mystacidium venosum	Ae																							
Oeceoclades mackenii	Ae																							
Polystachya ottoniana	A																							
Satyrium bracteatum						Fa																		
Satyrium longicauda																							X	
Satyrium parviflorum	Ae																						X	
POACEAE																								
Coix lacryma-jobi																Qi			T				X	
Cymbopogon marginatus						Faie				J													X	Y
Cymbopogon excavatus						F																		
Cymbopogon validus						Fe					K													
Eragrostis plana		B		D				H												U				
Imperata cylindrica						F					K													
Setaria megaphylla																				U				
TYPHACEAE																								
Typha capensis			C	Dp																				Y
ZINGIBERACEAE																								
Kaempferia sp.										J				N									X	
Siphonochilus aethiopica																								Y
Siphonochilus natalensis										J	K													
ANGIOSPERMAE - DICOTYLEDONAE																								
ACANTHACEAE																								
Adhatoda densiflora						Fe																		
Barleria ovata	Ae							Hc																
Blepharis capensis*																Q		Sr						
Crabbea hirsuta																							X	
Crabbea nana																Q		S					X	
Hypoestes aristata																					V			Y
Justicia flava										J														

Peristrophe hensii	V
Thunbergia atriplicifolia	E T
Thunbergia dregeana	A T
Thunbergia natalensis	Ae
Thunbergia venosa	Ae N
AIZOACEAE	
Aizoon canariense	Fe
Corbichonia decumbens	Fe
AMARANTHACEAE	
Achyranthes aspera	Fe Me
Achyropsis avicularis	Fe Ke T
Achyropsis leptostachya	Fe Ke
Hermbstaedtia odorata	F
Pupalia atropurpurea	Ke
Pupalia sp.	B
ANACARDIACEAE	
Harpephyllum caffrum	Fe He
Ozoroa paniculosa*	Fcd Jc Y
Protorhus longifolia*	M Or R T
Rhus chirindensis	M
Rhus laevigata	Fi
Sclerocarya birrea*	F He W X
ANNONACEAE	
Annona senegalensis	Fe N
Monanthotaxis caffra	Nse X
APIACEAE	
Alepidea amatymbica	F JcKs O X
Alepidea longifolia	J
Anethum graveolens	N R X
Berula erecta*	K
Bupleurum mundtii	Ae
Foeniculum vulgare	Ae N R X
Heteromorpha trifoliata*	Fad I J Ls N X Y
Lichtensteinia interrupta*	Fc J K N R X
Lichtensteinia kolbeana	Fc J
Pimpinella caffra	Ae Fa X
Pimpinella sp.	Ae
APOCYNACEAE	
Acokanthera oblongifolia*	Fa SeT Y
Acokanthera oppositifolia*	FaG H Sesr Y
Catharanthus roseus	G H I T
Oncinotis inandensis	Ae N
Rauvolfia caffra*	Dp F G H I Ke X
Strophanthus gerrardii*	X
Strophanthus petersianus*	X
Strophanthus speciosus*	Ss Y
Wrightia natalensis	E
AQUIFOLIACEAE	
Ilex mitis	Fi Ke T X
ARALIACEAE	
Cussonia spicata	C Fe Ke
ASCLEPIADACEAE	
Asclepias cucullata	X
Asclepias cultriformis	X
Asclepias flexuosa	X
Asclepias fruticosa*	Dp Fi Je L
Asclepias gibba	S
Asclepias meliodora	X
Asclepias physocarpa*	Ec X
Asclepias sp.*	B Y
Ceropegia woodii	Ne
Cynanchum obtusifolium*	Ne X
Huernia hystrix	X
Huernia sp.	X
Orbea variegata	X
Pachycarpus inconstans	F Ls Ns X Y
Pachycarpus natalensis	F Y
Pachycarpus scaber	X Y
Sarcostemma viminale*	D E Fe V
Schizoglossum atropurpureum	X
Secamone gerrardii	Fc M Or U
Secamone sp.	Ae
Sisyranthus huttoniae	N
Sisyranthus saundersiae	Ne
Sisyranthus trichostomus	Ne
Stapelia gigantea	NeOr U X
Tylophora flanaganii	F
Xysmalobium involucratum	X
Xysmalobium sp.	Y
Xysmalobium undulatum	F H Ls Ne T X Y
ASTERACEAE	
Achyrocline stenoptera	Ns
Adenostemma caffrum	Ae Fi K
Artemisia afra	F H Ks X
Aspilia natalensis	Fde JeKc T
Aster bakeranus*	C FiG J K L N S T Vs X
Aster serrulatus	F N
Aster spp.	L Se
Athrixia phylicoides	F H J
Berkheya rhapontica	J
Berkheya seminivea	Fe
Berkheya sp.	G Hc T U V
Berkheya speciosa	FcG V
Berkheya subulata	Fi V
Bidens pilosa	Fcdr Or
Blumea alata	F
Brachylaena discolor	Fa H J N
Brachylaena elliptica	Dp Fe Je N O Q Y
Callilepis laureola*	B Dp Fa Ni S Y
Conyza podocephala	J K T
Conyza scabrida	JrKc R Ur X
Conyza ulmifolia	J
Cotula anthemoides	Fi K
Crassocephalum rubens	Fe
Dicoma anomala	D Fad Hie J Q T W
Dicoma sp.	J Nr
Dicoma speciosa	J
Dicoma zeyheri	J
Eclipta prostrata*	Ae R
Ethulia conyzoides	Fa
Felicia erigeroides	Fac
Gazania rigens	Ae
Gerbera ambigua	Fa J
Gerbera piloselloides	Fa J Ks V
Helichrysum cooperi	X
Helichrysum decorum	Ns
Helichrysum foetidum	D T
Helichrysum nudifolium	Fi JeKs Ns T U
Helichrysum oxyphyllum	X
Helichrysum pedunculatum	J K T
Helichrysum pilosellum	Fi
Helichrysum spp.	D F T
Matricaria nigellifolia*	K T Y
Melanthera scandens	Fe
Microglossa mespilifolia	I K Y
Mikania capensis	C G K Ls T Y
Mikania natalensis	C Ls T Y
Nidorella sp.	S U
Osteospermum grandidentatum	Fe
Osteospermum imbricatum	Fe Ke
Osteospermum jucundum	F
Osteospermum scariosum	Fe
Othonna natalensis	Fa H Y
Pentzia pilulifera	T
Phymaspermum acerosum	X
Platycarpha glomerata	X
Printzia pyrifolia*	D F Ic N Y
Pulicaria scabra	D H I K V
Schistostephium hippiifolium	K
Senecio bupleuroides*	Dp J M
Senecio erubescens	Fc J K
Senecio inornatus	J M
Senecio lanceus	Dp
Senecio oxyriifolius	B K Nr Y
Senecio quinquelobus	F J Kc X
Senecio serratuloides*	H J Q T
Senecio sp.	C Jce
Senecio speciosus	Gr Jr Ls U
Senecio tamoides	Fc Y
Spilanthes mauritiana	Q
Ursinia anthemoides	W
Ursinia sp.	V
Ursinia tenuiloba	J
Vernonia adoensis	F J Kcr U W
Vernonia angulifolia	Fc
Vernonia hirsuta	F J Ls
Vernonia mespilifolia	Ae K
Vernonia natalensis	X
Vernonia neocorymbosa	Dp F N Y

Vernonia oligocephala	Fc X
Vernonia sp.	F
BALANITACEAE	
Balanites maughamii	N X
BALANOPHORACEAE	
Sarcophyte sanguinea	Fd I
BALSAMINACEAE	
Impatiens hochstetteri	T
BEGONIACEAE	
Begonia sp.	Fc Je X
Begonia sutherlandii	Fe X
BIGNONIACEAE	
Kigelia africana*	F X
BORAGINACEAE	
Cynoglossum hispidum	Ae F
Myosotis afropalustris	N
BRASSICACEAE	
Heliophila subulata	X
Lepidium capense	J
Lepidium pinnatum	J
Lepidium schinzii	C J
Lepidium sp.	C
CACTACEAE	
Rhipsalis baccifera	Je
CAMPANULACEAE	
Wahlenbergia grandiflora	N Y
Wahlenbergia sp.	Fi
Wahlenbergia undulata	Fe V X
CANELLACEAE	
Warburgia salutaris	FcG JsKec T U
CANNABACEAE	
Cannabis sativa	DsE J Y
CAPPARACEAE	
Cadaba natalensis	Je Ne R
Capparis brassii	Ae Je
Capparis tomentosa*	B H I Jes Lr N S U X Y
Cleome monophylla	Ae
CELASTRACEAE	
Cassine aethiopica	Fdc Y
Cassine crocea*	Fe
Cassine sp.	Ji
Cassine transvaalensis	Fce K
Catha edulis*	F
Maytenus heterophylla*	Fde Jr S U Y
Maytenus spp.	Fc J S
Pterocelastrus rostratus	Dr
Salacia leptoclada	A
CHENOPODIACEAE	
Chenopodium album*	Fa T W Y
Chenopodium ambrosioides*	F J W Y
CLUSIACEAE	
Hypericum aethiopicum*	C D F Gc T V
COMBRETACEAE	
Combretum apiculatum	Fc
Combretum caffrum	X
Combretum erythrophyllum*	Y
Combretum hereroense	Fc
Terminalia phanerophlebia	Jr Ne R
Terminalia sericea*	Jr Ne R
CONVOLVULACEAE	
Convolvulus farinosus	Fe
Ipomea ficifolia	F S
Ipomoea cairica*	F K Ne
Ipomoea congesta	F
Ipomoea crassipes	Fds Y
Ipomoea purpurea	C F He
Merremia tridentata	F
Turbina oblongata	X
CRASSULACEAE	
Cotyledon orbiculata*	Cc Q T U V X
Crassula alba	Fde Ks Ne
Crassula barbata	Fe
Crassula dependens	X
Crassula multicava	Fe
Crassula orbicularis	Fe
Crassula sarcocaulis	Fe
Crassula sp.	X
Crassula vaginata	Ae U X
Kalanchoe crenata	U X
Kalanchoe nr. paniculata	X
Kalanchoe rotundifolia*	Fe X
Kalanchoe sp.	V X
Kalanchoe thyrsiflora*	Dp Fac V X
CUCURBITACEAE	
Coccinia palmata	Fc
Cucumis africanus*	NeDc Y
Cucumis hirsutus*	F Jc
Cucumis myriocarpus*	A T X
Cucumis sp.*	F
Gerrardanthus macrorhizus	F
Lagenaria sphaerica*	Fc H I
Momordica balsamina*	F T
Momordica foetida	F H
CUNONIACEAE	
Cunonia capensis	N
DIPSACAEAE	
Cephalaria attenuata	Ki N X
Cephalaria zeyheriana	H I D
Scabiosa columbaria	Ae D T V
EBENACEAE	
Diospyros pallens	Fd
Diospyros villosa	Fc D Ur
Diospyros whyteana*	Dc
Euclea crispa*	D Fc J N O X
Euclea divinorum	F Q
Euclea natalensis*	C FcGcH IsJr
Euclea schimperi	D
Euclea sp.	C Je
Euclea undulata	Dp Fc L
EUPHORBIACEAE	
Acalypha peduncularis	H Je
Acalypha punctata	Je
Acalypha sp.	Ls
Andrachne ovalis*	Je Ls Se W X
Andrachne sp.	S
Antidesma venosum*	Fcd
Bridelia cathartica	Ae N R
Bridelia micrantha*	Fe Jr
Cavacoa aurea	K O Vs
Clutia affinis	F
Clutia heterophylla	Y
Clutia hirsuta	Ae Fc H K X Y
Clutia platyphylla	F
Clutia pulchella*	E Fdi L Ur X Y
Clutia sp.*	D S
Croton gratissimus*	Ae D F Gr IrJrKce N Q U
Croton sylvaticus*	A D F GrH IrJrKce U
Euphorbia bupleurifolia	Fe Ir T
Euphorbia ingens*	F I X
Euphorbia nr. woodii	D T
Euphorbia pugniformis	Ir T
Jatropha hirsuta	Kc T X
Jatropha zeyheri	H T
Margaritaria discoidea*	Ae
Monadenium lugardae*	F N
Phyllanthus meyerianus	J K L
Phyllanthus reticulatus	N X
Ricinus communis*	Fc Q T Y
Spirostachys africana*	F Ls Ti Vs Y
Synadenium cupulare*	J Ls Q R X
Tragia meyeriana	G
FABACEAE	
Abrus precatorius*	Ae J
Acacia caffra	Ae Fi He

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Acacia gerrardii													Nces										
Acacia karroo						Fdi							Ne										
Acacia nilotica									J														
Acacia rehmanniana														Oc				T					
Acacia xanthophloea										Ke													
Afzelia quanzensis																		T					
Albizia adianthifolia*	Ae					F												T		V			
Albizia forbesii													N										
Albizia sp.										Kc													
Albizia suluensis*										Kc			N										
Alysicarpus rugosus									JeKe														
Argyrolobium sp.																		T					
Argyrolobium marginatum						F																	
Argyrolobium natalense	Ae																						
Argyrolobium speciosum		Be																					
Argyrolobium stipulaceum																	S						
Argyrolobium tomentosum													Ne										
Calpurnia aurea																		T			W		Y
Calpurnia villosa																					W		Y
Cassia floribunda																						X	
Cassia italica*									J	K													
Cassia mimosoides						Fd							N					T					
Cassia occidentalis*						F							N	O			S				W	X	
Cassia sp.																						X	
Crotalaria lanceolata*																						X	
Crotalaria sp.*									J														
Dalbergia obovata	Ae														Qi		S						
Dialium schlechteri																		T					
Dichrostachys cinerea														Or									
Elephantorrhiza elephantina*	Ae		C			Fdce			J	Ke								T					
Elephantorrhiza sp.*												Mer											
Entada spicata			Cr									MeNe						T					Y
Eriosema cordatum	A	B																					y
Eriosema distinctum		B					G																
Eriosema salignum		B																					Y
Erythrina caffra*			C				G													V			
Erythrophleum lasianthum*						F				KsLs			N			R							y
Indigofera cylindrica						Fa																	Y
Indigofera eriocarpa						Fd																	
Indigofera hilaris*						Fd																	
Indigofera micrantha						Fd																	
Indigofera spp.						Fd			J	K			N									X	
Indigofera tenuissima*									J														
Indigofera velutina						Fd																	
Lonchocarpus capassa*						Fd																	
Lotus discolor									J														
Macrotyloma axillare																							y
Millettia grandis													Ns										
Mundulea sericea*													Ne										
Newtonia hildebrandtii													N									X	
Ormocarpum trichocarpum													Ne										
Peltophorum africanum		Bc																					
Psoralea pinnata													Ne										
Rhynchosia nervosa	Ae																						
Rhynchosia sp.	A										L												
Schotia brachypatala						Fd		He															
Sphenostylis angustifolia						Fe		He															
Tephrosia capensis*						Fe					LsM		N										
Tephrosia densiflora*																					W		
Tephrosia diffusa*																		T			W		
Tephrosia elongata						Fe																	
Tephrosia grandiflora									Je												W		
Tephrosia kraussiana									J														
Tephrosia lurida	Ae																					X	
Tephrosia macropoda*									J	K								T			W		Y
Tephrosia purpurea*																					W		
Tephrosia toxicaria*																					W		
Tephrosia vogelii																					W		
Vigna luteola	Ae									Ke													
Vigna unguiculata	Ae									Ke													
Vigna vexillata	Ae									Ke													
Zornia capensis																						X	

FLACOURTIACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Dovyalis rhamnoides										K													
Gerrardina foliosa				Dp						K	L		N									X	
Homalium dentatum						F																	
Trimeria grandifolia						Fc																	
Xylotheca kraussiana	Ae																						

GENTIANACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Chironia purpurascens						F																	
Sebaea bojeri	Ae																						
Sebaea crassulifolia						Fd											S						
Sebaea grandis	Ae																						
Sebaea sedoides	Ae					Fi																	
Sebaea sp.	Ae																						

GERANIACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Geranium ornithopodon									JsKi														
Monsonia emarginata						Fd											S						y
Pelargonium luridum						Fd																X	Y
Pelargonium sidifolium			C			Fd																	
Pelargonium spp.						Fd			J	K												X	Y

GESNERIACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Streptocarpus prolixus																							Y
Streptocarpus sp.				D																			

GREYIACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Greyia sutherlandii						Fe																	

HALORAGACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Gunnera perpensa		B		Dp			G			K													Y

ICACINACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Apodytes dimidiata						Fa							N									X	Y
Pyrenacantha grandiflora	Ae																						
Pyrenacantha scandens	A	B		Dp																			

ILLECEBRACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Dianthus crenatus	Ae												Ne									X	
Pollichia campestris									Js														
Silene bellidioides	Ae																						
Silene burchellii	Ae																						

LAMIACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Becium knyanum																		T					
Becium obovatum						Fi												T					
Leonotis leonurus						Fd			JcK		Ls						Se						Y
Leonotis ocymifolia						F				K													Y
Leucas martinicensis										Ki													
Mentha aquatica										K												X	
Mentha longifolia									J	KcL													
Plectranthus ambiguus										K													
Plectranthus hadiensis						Fc															W		Y
Plectranthus laxiflorus						Fc				Kc					Q								Y
Plectranthus madagascariensis						Fc			J									T					
Plectranthus sp.										K													
Plectranthus sp.										K													
Plectranthus sp.									J														
Pycnostachys reticulata															Q								
Salvia scabra					E																		
Stachys nigricans	Ae																						
Syncolostemon densiflorus	Ae																						
Syncolostemon parviflorus						Fi		He															
Tetradenia riparia						F	G		JeK														Y
Teucrium kraussii								H									Se						

LAURACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Cryptocarya latifolia									J														
Ocotea bullata							G				Ls			Or					U				

LECYTHIDACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Barringtonia racemosa*										Ke													

LENTIBULARIACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Utricularia livida						Fi																	
Utricularia prehensilis	Ae																						

LINACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Linum thunbergii								He						O			S					X	Y

LOBELIACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Cyphia elata						Fe																	
Lobelia coronopifolia				D																			
Lobelia erinus										Ks												X	
Lobelia patula															Qi								
Monopsis decipiens										K													
Monopsis scabra										K													

LOGANIACEAE

	A	B	C	D	E	F	G	H	J	K	L	M	N	O	Q	R	S	T	U	V	W	X	Y
Buddleia salviifolia*																R						X	
Nuxia floribunda													N										
Nuxia oppositifolia	A																						
Strychnos decussata						F																	
Strychnos henningsii*				D		Fa				K				O									
Strychnos spinosa										Ke							Se			V			

LORANTHACEAE
Erianthemum dregei Fi Y

MALPIGHIACEAE
Acridocarpus natalitius N X

MALVACEAE
Hibiscus aethiopicus F U
Hibiscus pedunculatus G
Hibiscus pusillus Ae Ne
Hibiscus surattensis C G U
Sida dregei T
Thespesia acutiloba X

MELASTOMATACEAE
Dissotis canescens Fd

MELIACEAE
Ekebergia capensis Ae Fae H J Ne
Trichilia dregeana Fcd O
Trichilia emetica* FdGc Oc
Turraea floribunda* Ge MeNeOe
Turraea obtusifolia* Fce

MELIANTHACEAE
Bersama lucens* B D P X
Melianthus comosus* F H O S T U V
Melianthus dregeanus* F H S

MENISPERMACEAE
Cissampelos mucronata X
Cissampelos sp. Dp
Cissampelos torulosa C Ic Q
Stephania abyssinica H X

MESEMBRYANTHEMACEAE
Aptenia cordifolia Ae Fic Nr T
Carpobrotus edulis FiG J
Delosperma velutinum Fe
Mesembryanthemum sp. Fce Ir NeOr U

MORACEAE
Ficus ingens H Y
Ficus natalensis Dp
Ficus sur J Y
Ficus sp. H

MYRICACEAE
Myrica serrata D J K L X

MYRSINACEAE
Embelia ruminata* Fa H
Maesa alnifolia Ae Fa
Maesa lanceolata* Fae
Maesa sp. Fa
Rapanea melanophloeos Fec J M

MYRTACEAE
Eucalyptus sp. Ks W
Eugenia albanensis Fd
Heteropyxis natalensis Y
Syzygium cordatum* Fe J
Syzygium gerrardii J

OCHNACEAE
Ochna natalitia B
Ochna serrulata Fc

OLEACEAE
Jasminum multipartitum Ae
Jasminum sp.* Fc
Olea europaea G J L X

OXALIDACEAE
Oxalis semiloba* Qi

PASSIFLORACEAE
Adenia gummifera* Fe H Ke M P X
Basananthe sandersonii A

PEDALIACEAE
Ceratotheca triloba D F

PERIPLOCACEAE
Mondia whitei F H
Raphionacme sp. Fa H I K
Tacazzea apiculata H

PHYTOLACCACEAE
Phytolacca americana* Fe I J S T W
Phytolacca dodecandra* Bc G Ke
Phytolacca heptandra* F Gc J Ne S Y
Phytolacca octandra* J Ne S T Y

PITTOSPORACEAE
Pittosporum viridiflorum Fce H Ke N Oc

PLANTAGINACEAE
Plantago major DpE Fd T

PLUMBAGINACEAE
Plumbago auriculata* Ls Ne Ur X

POLYGALACEAE
Polygala fruticosa Dp G H IsJ
Polygala galpinii Ae
Polygala hottentotta Fc X Y
Polygala serpentaria Ae Fi
Polygala sp. J
Polygala virgata He

POLYGONACEAE
Emex australis Fc Y
Oxygonum dregeanum Fe
Polygonum lapathifolium C
Polygonum salicifolium T
Rumex lanceolatus B D FaidH T Y
Rumex sagittatus F J K Ls O Q

PORTULACACEAE
Portulaca quadrifida Fe
Talinum caffrum Fci Je N

PTAEROXYLACEAE
Ptaeroxylum obliquum* Es Ls X Y

RANUNCULACEAE
Anemone caffra Fce N R X
Clematis brachiata C Fac K Ls T X
Knowltonia anemonoides Cc Ls
Ranunculus multifidus* C E Fd G I J Ls T
Ranunculus sp. Ls X Y
Thalictrum rhynchocarpum X

RHAMNACEAE
Berchemia discolor T X
Berchemia zeyheri Fdi Oc X
Helinus integrifolius Ae Ne
Rhamnus prinoides H J U X
Ziziphus mucronata I Je O Q T U

ROSACEAE
Agrimonia eupatoria Fa J
Leucosidea sericea Fa V X
Prunus africana* R X
Rubus ludwigii F O
Rubus pinnatus J V
Rubus rigidus Fd O V

RUBIACEAE
Agathisanthemum bojeri Ae
Burchellia bubalina Ae Ne X
Canthium ciliatum Fa N
Canthium inerme Fd
Catunaregam spinosa* Ke
Coddia rudis B Ke
Conostomium natalense Ae
Gardenia cornuta Fe
Gardenia ternifolia Ke
Gardenia thunbergia Fe Ke
Gardenia volkensii Fe
Hyperacanthus amoenus Fe
Kohautia amatymbica AeB E Hi Ne
Lagynias lasiantha Fd
Oldenlandia affinis J M
Oldenlandia corymbosa Ae N X
Oldenlandia sp. Ae
Pavetta spp. H N

Pentanisia prunelloides	C Dp Fc H I J K N O S T U
Pentodon pentandrus	Fe
Psychotria capensis	Fe
Rubia cordifolia	AeB D F J N Q X
Spermacoce natalensis	Fd J M N T
RUTACEAE	
Calodendrum capense	X
Clausena anisata	EsFac Ki MsNeO
Vepris undulata	F Ke
Zanthoxylum capense	B Fac H IsJei Or Q S T
Zanthoxylum davyi	H J K Ser Y
SALVADORACEAE	
Azima tetracantha	Q
SANTALACEAE	
Osyridicarpos schimperianus	X
SAPINDACEAE	
Cardiospermum halicacabum*	C Fdc H Js T
Deinbollia oblongifolia	Fd N
Hippobromus pauciflorus*	Ae Fd Ls Ne V Y
SAPOTACEAE	
Sideroxylon inerme	Kc Ne Ur Y
SCROPHULARIACEAE	
Buchnera dura	Ae X
Cycnium racemosum	D Oe
Cycnium tubulosum	Ae X
Graderia scabra	Aes D Fc K T X
Halleria lucida	V X
Harveya speciosa	F N U
Manulea parviflora	Fi
Peliostomum calycinum	Fi K T
Sutera floribunda	D J
Sutera kraussiana	D
Sutera sp.	Ke Ns
Zaluzianskya maritima	Ae
SELAGINACEAE	
Hebenstretia sp.	X
Selago sp.	Sr U
Tetraselago natalensis	C
SOLANACEAE	
Datura metel*	Ls N T
Datura stramonium*	I Ls N T U
Physalis peruviana*	Fi
Solanum sp.*	B F
Solanum acanthoideum	T
Solanum aculeastrum*	Or Q Ur Y
Solanum aculeatissimum*	S
Solanum capense	C G Q S T Vr
Solanum giganteum	J
Solanum incanum*	Q T
Solanum mauritianum*	Fe
Solanum nigrum*	Fi Or T
Solanum panduriforme	Q T
Solanum tomentosum	C Q T
Withania somnifera*	C Fi I J Ki Nc T Y
STERCULIACEAE	
Dombeya rotundifolia	Fc M
Hermannia depressa	Ae Fd J N X
Hermannia grandistipula	Y
THYMELAEACEAE	
Gnidia anthylloides*	J Ks Ns S
Gnidia calocephala	T
Gnidia cuneata	H Kc Q S T
Gnidia kraussiana*	Dp Fc J O S Y
Gnidia polyantha	Ae T
Gnidia spp.	H S T V
TILIACEAE	
Corchorus asplenifolius	A
Grewia caffra	Gc
Grewia occidentalis	D Gc T X
Triumfetta pilosa	T
Triumfetta rhomboidea	Dp
TRIMENIACEAE	
Xymalos monospora	F
ULMACEAE	
Chaetacme aristata*	F Q
Trema orientalis	Fe
URTICACEAE	
Laportea grossa	Y
Laportea peduncularis	Y
Pouzolzia mixta	Kc X
Urtica urens	B Y
VERBENACEAE	
Clerodendrum glabrum	FaGe J K Y
Clerodendrum hirsutum	Fa I
Clerodendrum myricoides	S
Clerodendrum suffruticosum	S
Clerodendrum triphyllum	Dp Gc I
Lantana rugosa	Fi J T V
Lippia javanica	F J K T
Priva cordifolia	T V
Vitex rehmannii	Fc J N
Vitex wilmsii	J NeOc
VIOLACEAE	
Hybanthus enneaspermus	H
Hybanthus sp.	Ae
VISCACEAE	
Viscum sp.	Fi J N O T
VITACEAE	
Cissus quadrangularis	Y
Cyphostemma hypoleucum	Kc
Cyphostemma lanigerum	Q
Cyphostemma natalitium	Dp Y
Rhoicissus tomentosa*	Y
Rhoicissus tridentata*	B Dp K X

Bothalia 19,1: 125–132 (1989)

Chromosome studies on African plants. 9. Chromosome numbers in *Ehrharta* (Poaceae: Ehrharteae)

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Keywords: aneuploidy, chromosome numbers, *Ehrharta*, meiosis, polyploidy, southern Africa, winter rainfall area

ABSTRACT

Cytogenetic studies of 53 specimens of 14 species of the genus *Ehrharta* Thunb. confirmed a basic chromosome number of 12 for the genus. Chromosome numbers for 13 species are described for the first time. The highest ploidy level yet observed in the genus (2n = 10x = 120) is reported for *E. villosa* var. *villosa*. B chromosomes were observed in several specimens of four different species.

UITTREKSEL

Sitogenetiese studies van 53 eksemplare, verteenwoordigend van 14 spesies van die genus *Ehrharta* Thunb., bevestig 'n basiese chromosoomgetal van 12 vir die genus. Chromosoomgetalle van 13 spesies word vir die eerste keer beskryf. Die hoogste poliploïede vlak wat nog in die genus beskryf is (2n = 10x = 120), is by *E. villosa* var. *villosa* gevind. B-chromosome is by verskeie eksemplare van vier verskillende spesies waargeneem.

INTRODUCTION

The presentation of chromosome numbers in this report continues with the format established in the first publication in this series (Spies & Du Plessis 1986). However, contrary to previous publications in this series which all dealt with several different genera of the family Poaceae, this paper covers the single genus, *Ehrharta* Thunb. The results presented here are limited to the species from the winter rainfall area of southern Africa.

The winter rainfall region of southern Africa, with its Mediterranean climate, is located in the extreme southwest of the continent. Though small in area, less than 4% of the total land surface of southern Africa, it is floristically extremely important, being recognized as one of the six Floral Kingdoms of the world (Goldblatt 1978). The flora of the Cape Floristic region, or Fynbos Biome, is unique in many respects, being particularly rich in species (Goldblatt 1978), with high levels of endemism. Thus, in the 87 244 km^2 of the Cape Region (Fynbos and Succulent Karoo Biomes combined), there are over 8 000 species of which 73% are endemic (Gibbs Russell 1987). High species diversity characterizes this fynbos vegetation (Gibbs Russell 1987) and this is also the case with the grasses of this biome. Although relatively inconspicuous in this vegetation, the fynbos grasses are particularly interesting as many of them are restricted to this region and are poorly known taxonomically.

Ehrharta is one of the grass genera with a high proportion of its species endemic to the Fynbos Biome. All but three of the southern African species are endemic to the Fynbos Biome (Gibbs Russell pers. comm.). The genus belongs to the tribe Ehrharteae Nevski and, as currently classified, is represented by 30 species (with 16 infraspecific taxa) in southern Africa (Gibbs Russell & Ellis 1987). Gibbs Russell & Ellis (1987) subdivided the South African representatives of the genus into seven species groups, i.e. the Setacea, Capensis, Erecta, Calycina, Villosa, Ramosa and Dura groups. The higher classification of the tribe Ehrharteae, which has been reviewed by Gibbs Russell & Ellis (1987), is still unresolved. Most recently Clayton & Renvoize (1986) included the tribe in the subfamily Bambusoideae. However, both Soderstrom & Ellis (1987) and Kellogg & Campbell (1987) excluded it from the Bambusoideae, to which they considered the Ehrharteae to be a sister group.

The aim of this study was to determine the chromosome numbers and the meiotic chromosome behaviour of as many different species as possible. Future studies will determine whether this information can contribute to the delimitation of species in the genus, as well as to clarifying the position of the Ehrharteae in the Poaceae.

MATERIALS AND METHODS

The material used during this study was collected and fixed in the field. A list of the material used and the localities are listed under results. Voucher herbarium specimens are housed in PRE.

Inflorescences were fixed in Carnoy's fixative (1886). After 24–48 hours of fixation, the fixative was replaced by 70% ethanol. Anthers were squashed in aceto-carmine (Darlington & La Cour 1976). Slides were permanently mounted by freezing them with liquid CO_2, followed by dehydration in ethanol and mounting in Euparal.

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RESULTS

Family Poaceae, Tribe Ehrharteae, Genus *Ehrharta*.

Capensis group

Capensis subgroup

Ehrharta barbinodis Nees ex Trin.: **n = 12.**

CAPE.—2917 (Springbok): 1 km from Springbok to Hondeklip Bay (−DD), *Spies 3000*.

E. capensis Thunb.: **n = 12.**

CAPE.—3218 (Clanwilliam): Versveld Pass (−DC), *Spies 3168*.

Longifolia subgroup

No results.

Erecta group

E. erecta Lam. var. *erecta*: **n = 12.**

CAPE.—3325 (Port Elizabeth): King Neptune Beach (−DC), *Spies 3478*.

E. erecta Lam. var. *natalensis* Stapf: **n = 12.**

CAPE.—3323 (Willowmore): Blouwkransrivier Pass (−DC), *Davidse 33656*.

E. triandra Nees ex Trin.: **n = 12 & 24.**

CAPE.—2917 (Springbok): 21 km from Springbok to Kleinsee (−DA), *Davidse 33240* (n = 24). 3018 (Kamiesberg): 6 km east of Kamieskroon (−BD), *Davidse 33320* (n = 12).

E. longiflora J. E. Sm.: **n = 12 & 24.**

CAPE.—2918 (Gamoep): 21 km from Springbok to Kleinsee (−CA), *Spies 3343* (n = 12). 3018 (Kamiesberg): 52 km from Springbok to Loeriesfontein (−AA), *Spies 3375* (n = 12); Buffelsrivier Valley between Pedroskloof and Bobbejaanshoek (−AA), *Davidse 33308* (n = 12); 6 km east of Kamieskroon (−BD), *Spies 2992* (n = 12). 3418 (Simonstown): Redhill, 4 km from Simonstown (−AB), *Spies 3233* (n = 24).

Calycina group

E. brevifolia Schrad. var. *brevifolia*: **n = 12.**

CAPE.—3017 (Hondeklipbaai): coastal dunes near Groenrivier (−DC), *Davidse 33365*.

E. brevifolia Schrad. var. *cuspidata* Nees: **n = 12 + 0−1B.**

CAPE.—2917 (Springbok): 36 km from Port Nolloth to Kleinsee (−AC), *Davidse 33273*; *Spies 3361*, *3362*. 3017 (Hondeklipbaai): 15 km east of Hondeklip Bay (−AB), *Spies 3028*; 42 km west of Garies towards Groenriviersmond (−DC), *Spies 3383*.

E. calycina J. E. Sm.: **n = 12, 12 + 0−2B, 24 & 24 + 2B.**

CAPE.—2917 (Springbok): 17 km from Okiep to Goodhouse (−BD), *Spies 2995* (n = 12); 1 km from Springbok to Hondeklip Bay (−DD), *Spies 3003* (n = 12 + 0−2B), *3005* (n = 24). 3017 (Hondeklipbaai): 6 km east of Kamieskroon in Kamiesberg Pass (−BB), *Davidse 33321* (n = 24), *33326* (n = 12 + 0−2B); *Spies 3380* (n = 12); 42 km from Garies to Groenrivier (−DC), *Spies 3393* (n = 12); 3 km south of Groenrivier on road to Kotzerus (−DD), *Davidse 33371* (n = 12 + 2B). 3018 (Kamiesberg): 16 km east of Kamieskroon (−AC), *Spies 3058* (n = 24), *3062* (n = 12); Rooiberg in Kamiesberg Range (−AC), *Davidse 33337* (n = 12), *33349* (n = 24 + 2B). 3118 (Vanrhynsdorp): Gifberg Pass (−DC), *Spies 3094* (12 + 2B), *3095* (n = 12); 24 km from Clanwilliam to Elizabethfontein (−DD), *Davidse 33417* (n = 12). 3119 (Calvinia): Vanrhyns Pass (−AC), *Spies 3110* (n = 12); top of Botterkloof Pass (−CD), *Davidse 33401* (n = 12). 3318 (Cape Town): near Stellenbosch turnoff on road between Paarl and Franschhoek (−DD), *Spies 3198* (n = 12 + 2B). 3321 (Ladismith): Seweweekspoort Pass (−AD), *Spies 3272* (n = 12 + 0−2B). 3323 (Willowmore): 5 km from Avontuur to Uniondale (−CA), *Davidse 33687* (n = 24). 3419 (Caledon): 5 km from Hermanus to Onrustrivier (−AC), *Davidse 33828* (n = 12 + 0−2B). 3421 (Riversdale): 4 km from Kweekkraal to Droërivier (−AA), *Spies 3549* (n = 12 + 0−2B); 2 km from Vermaaklikheid to Puntjie (−AC), *Spies 3562* (n = 12). 3424 (Humansdorp): Skuitbaai (−AA), *Davidse 33638* (n = 12).

E. delicatula (Nees) Stapf: **n = 12.**

SWA/NAMIBIA.—2616 (Aus): near Aus (−CB), *Spies 2927*.

CAPE.—2917 (Springbok): 57 km from Kleinsee to Springbok (−DA), *Davidse 33285*.

E. melicoides Thunb.: **n = 12.**

CAPE.—3018 (Kamiesberg): Rooiberg in the Kamiesberg Range (−AC), *Davidse 33346*. 3119 (Calvinia): 25 km from Calvinia to Clanwilliam (−CA), *Spies 3122*. 3420 (Bredasdorp): 6 km from Malgas to Bredasdorp (−AD), *Spies 3251*.

E. pusilla Nees ex Trin.: **n = 12.**

CAPE.—2918 (Gamoep): 53 km from Springbok to Gamoep (−CC), *Davidse 33302*. 3018 (Kamiesberg): Buffelsrivier Valley between Pedroskloof and Bobbejaanshoek (−AA), *Davidse 33310*; 52 km from Springbok to Loeriesfontein (−AA), *Spies 3374*.

Villosa group

E. villosa Schult. f. var. *villosa*: **n = 60.**

CAPE.—3424 (Humansdorp): 27 km from Humansdorp to Cape St. Francis (−BB), *Spies 3505*.

Ramosa group

E. ramosa (Thunb.) Thunb. subsp. *ramosa*: **n = 12.**

CAPE.—3324 (Steytlerville): 71 km from Rocklands to Elandsrivier (−DB), *Spies 3490*.

E. rehmannii Stapf subsp. *rehmannii*: **n = 12 + 0−5B.**

CAPE.—3322 (Oudtshoorn): Montagu Pass (−CD), *Davidse 33708*.

E. rehmannii Stapf subsp. *subspicata* Stapf: **n = 36.**

CAPE.—3323 (Willowmore): 9 km from Coldstream to Humansdorp (−DD), *Spies 3515*.

Dura group

E. dura Nees ex Trin.: **n = 12 + 0−4B.**

CAPE.—3322 (Oudtshoorn): Robinson Pass (−CC), *Davidse 33534*.

DISCUSSION

According to Watson *et al.* (1986) the basic chromosome number of the genus *Ehrharta* is 12 and ploidy levels vary from diploid to tetraploid. This study confirms the basic chromosome number but increases the

range of polyploidy from diploid to decaploid. In order to place the cytogenetic results in a taxonomic context, the results are discussed according to the species groups of Gibbs Russell & Ellis (1987).

Both species studied in the Capensis subgroup of the Capensis group, i.e. *E. barbinodis* and *E. capensis*, were diploid with no meiotic abnormalities (Figure 1A). This is the first reported chromosome number for both species.

The described diploid and tetraploid levels in the Erecta group (Parthasarathy 1939; De Wet & Anderson 1956; Tateoka 1965; Raven *et al.* 1965; Fernandes & Queiros 1969; Davidse *et al.* 1986; Spies & Du Plessis 1986; Hoshino & Davidse 1988) are supported by this study. Chromosome numbers are reported for the first time for *E. erecta* var. *natalensis* (n = 12) and *E. triandra* (n = 12 & 24) (Figure 1B), as well as a new ploidy level for *E. longiflora* (n = 12). Results reported up to now indicate that 72 % of the sampled plants are diploid. With the exception of *E. erecta* var. *natalensis*, of which only one specimen has been studied, the four other taxa of the group have both diploid and tetraploid specimens. *E. triandra* and *E. longiflora* are closely related and have many morphological similarities, with *E. longiflora* being larger than *E. triandra*. However, since both species have been shown to have diploid and tetraploid populations, this size difference cannot be attributed to different ploidy levels.

The Calycina group was the most thoroughly studied with counts from 45 plants, representing six of the seven taxa. Both diploid (84%) and tetraploid (16%) specimens were observed (Figure 2D–L) which corroborates published results (Parthasarathy 1939; Love 1948; Tateoka 1957; De Wet 1960; Tothill & Love 1964; Spies & Du Plessis 1986; Hoshinso & Davidse 1988; Spies & Voges 1988). The polymorphic *E. calycina* diploid forms include prostrate coastal plants with short, broad leaf blades as well as the very common, widely distributed plants with erect growth habit and flat leaf blades. The tetraploid form of *E. calycina* seems to be restricted to densely tufted plants with erect, narrow, often rolled leaf blades. The chromosome numbers reported here for *E. brevifolia* var. *brevifolia* and *E. brevifolia* var. *cuspidata* (Figure 2A–C), as well as *E. delicatula* and *E. melicoides*, are the first reported numbers for the taxa.

A very high frequency of specimens from the Calycina group were aneuploid (24%) with one or two additional chromosomes, although most had two. With the exception of one *E. brevifolia* var. *brevifolia* specimen, these additional chromosomes were restricted to *E. calycina*. Love (1948), Tothill & Love (1964) and Spies & Voges (1988) have previously reported one to six additional chromosomes beyond the basic complement(s) in *E. calycina*. Tothill & Love (1964) referred to these additional chromosomes as supernumerary chromosomes and Spies & Voges (1988) called them B chromosomes. Both groups of authors observed no size or behavioural differences between the additional and standard chromosomes. As in these three previous studies, we observed meiotic irregularities, including late disjunction of bivalents during the first division (Figure 2L) and non-alignment of chromosomes on the metaphase plate (Figure 2J). As was also observed in these previous studies, the extra chromosomes may sometimes pair, either as multivalents or as bivalents (Figure 2F). Additional abnormalities observed during meiosis include the presence of univalents in a diploid specimen *Davidse 33371* (n = 12) and up to six anaphase I laggards in *Davidse 33321* (n = 24) (Figure 2L).

A very narrow spindle on one side of the cell was observed in an *E. delicatula* specimen *(Davidse 33285)* (Figure 3A & B). Specimens of both *E. brevifolia* and *E. delicatula* had two chromosome pairs associated with the nucleolus (Figure 2A & B).

Only one specimen of the Villosa group was successfully analysed. This specimen, *Spies 3505 (E. villosa* var. *villosa)*, provides the first chromosome number report for a member of this group and it proved to have the highest ploidy yet described in the Ehrharteae, i.e. n = 60 (Figure 4A & B). Apart from a few multivalents and univalents observed in this specimen, meiosis in this decaploid was normal and no laggards were observed, which is surprising in view of the high ploidy level.

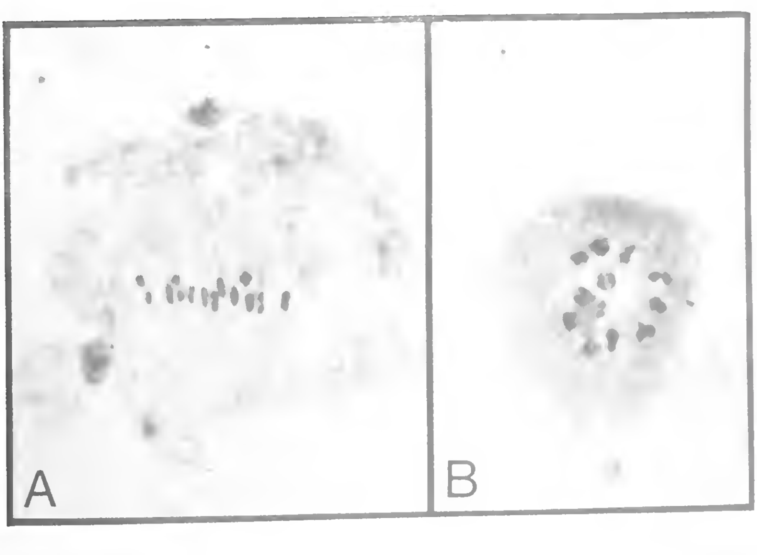

FIGURE 1.—Meiotic chromosomes in: A, the Capensis subgroup, *E. capensis*, *Spies 3168*, metaphase I with 12 bivalents; B, the Erecta group, *E. triandra*, *Davidse 33320*, diakinesis with 12 bivalents of which four are associated with the nucleolus, × 1300.

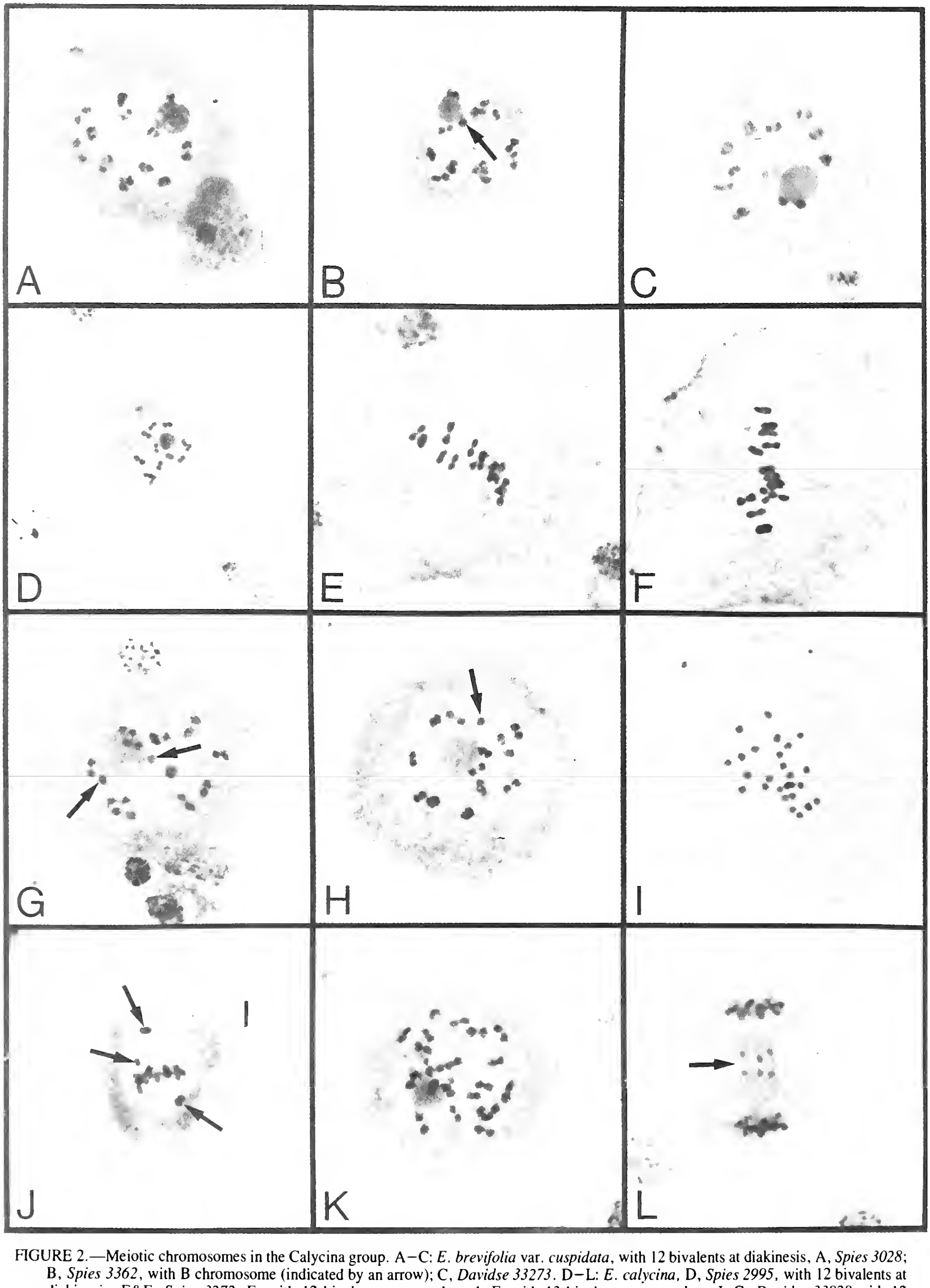

FIGURE 2.—Meiotic chromosomes in the Calycina group. A–C: *E. brevifolia* var. *cuspidata*, with 12 bivalents at diakinesis, A, *Spies 3028*; B, *Spies 3362*, with B chromosome (indicated by an arrow); C, *Davidse 33273*. D–L: *E. calycina*, D, *Spies 2995*, with 12 bivalents at diakinesis; E&F, *Spies 3272*, E, with 12 bivalents at metaphase I; F, with 13 bivalents at metaphase I; G, *Davidse 33828* with 12 bivalents and 2 B chromosomes at diakinesis (indicated by arrows); H, *Davidse 33371*, with 12 bivalents and a B chromosome at diakinesis (indicated by an arrow); I, *Spies 3198*, with 26 chromosomes during early anaphse I; J, *Spies 3003*, with 2 B chromosomes during metaphase I (non-alignment of chromosomes indicated by arrows); K & L, *Davidse 33321*, with 24 bivalents at diakinesis and 3 lagging, late dividing bivalents at anaphse I (indicated by an arrow). D & J, × 730; rest, × 1200.

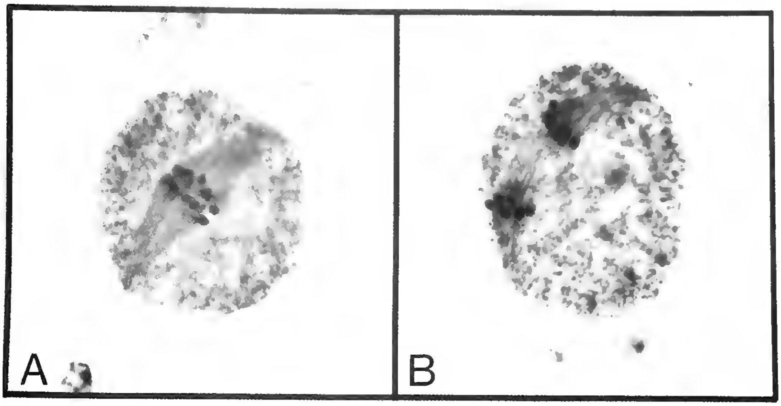

FIGURE 3.—Meiotic chromosomes in the Calycina group: A & B, *E. delicatula*, *Davidse 33285*, with 12 bivalents and a very distinct and narrow spindle, which may be off-centre, B, × 1100.

Three specimens of the Ramosa group were counted and the counts represent the first chromosome number reports for these species. The *E. ramosa* subsp. *ramosa* specimen was a normal diploid plant (Figure 5A & B). The *E. rehmannii* subsp. *rehmannii* specimen was a diploid with 0–5 B chromosomes (Figure 5C – E). During metaphase I the B chromosomes were indistinguishable from the euchromosomes but at the end of anaphase I they seemed to despiralize (Figure 5D). It seems as if the division of these normal bivalents into chromosomes and the division of the univalents into chromatids is not synchronized. The *E. rehmannii* subsp. *subspicata* specimen had the second highest ploidy level found in the Ehrharteae, with n = 36. A low frequency of multivalents (up to hexavalents) were observed in this subspecies (Figure 5F & G). In addition,

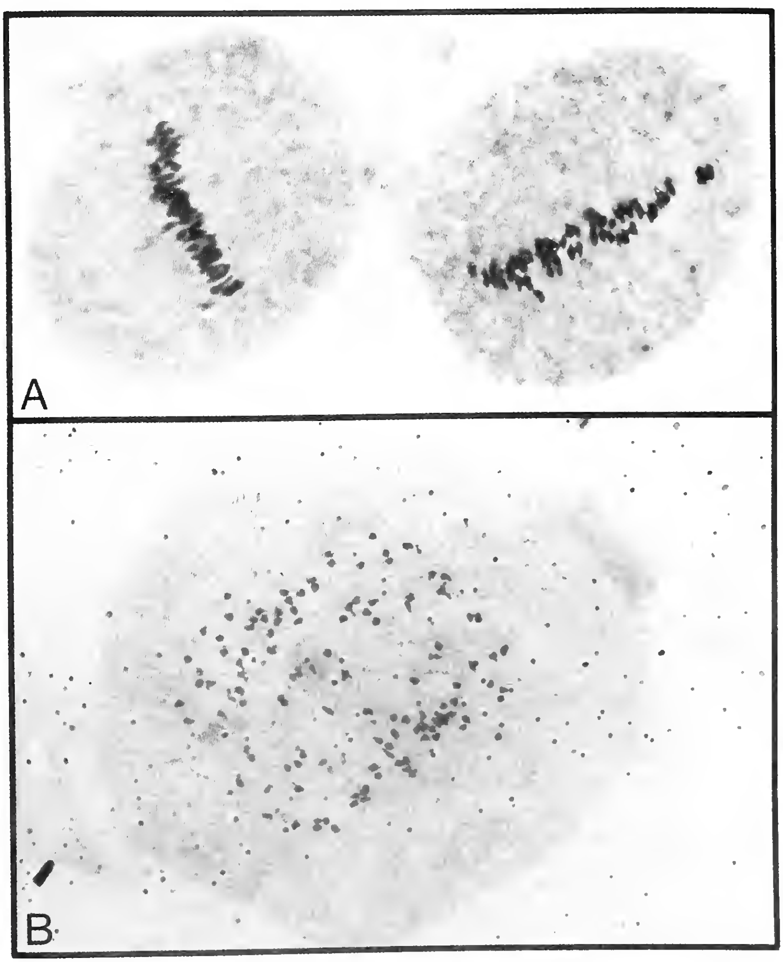

FIGURE 4.—Meiotic chromosomes in the Villosa group. A & B, *E. villosa* var. *villosa*, *Spies 3505*, A, 60 bivalents in metaphase; B, 120 chromosomes during anaphase I. Additional chromosome-like images in the photograph were caused by crystalization of stain which can be differentiated from the chromosomes under the microscope, × 930.

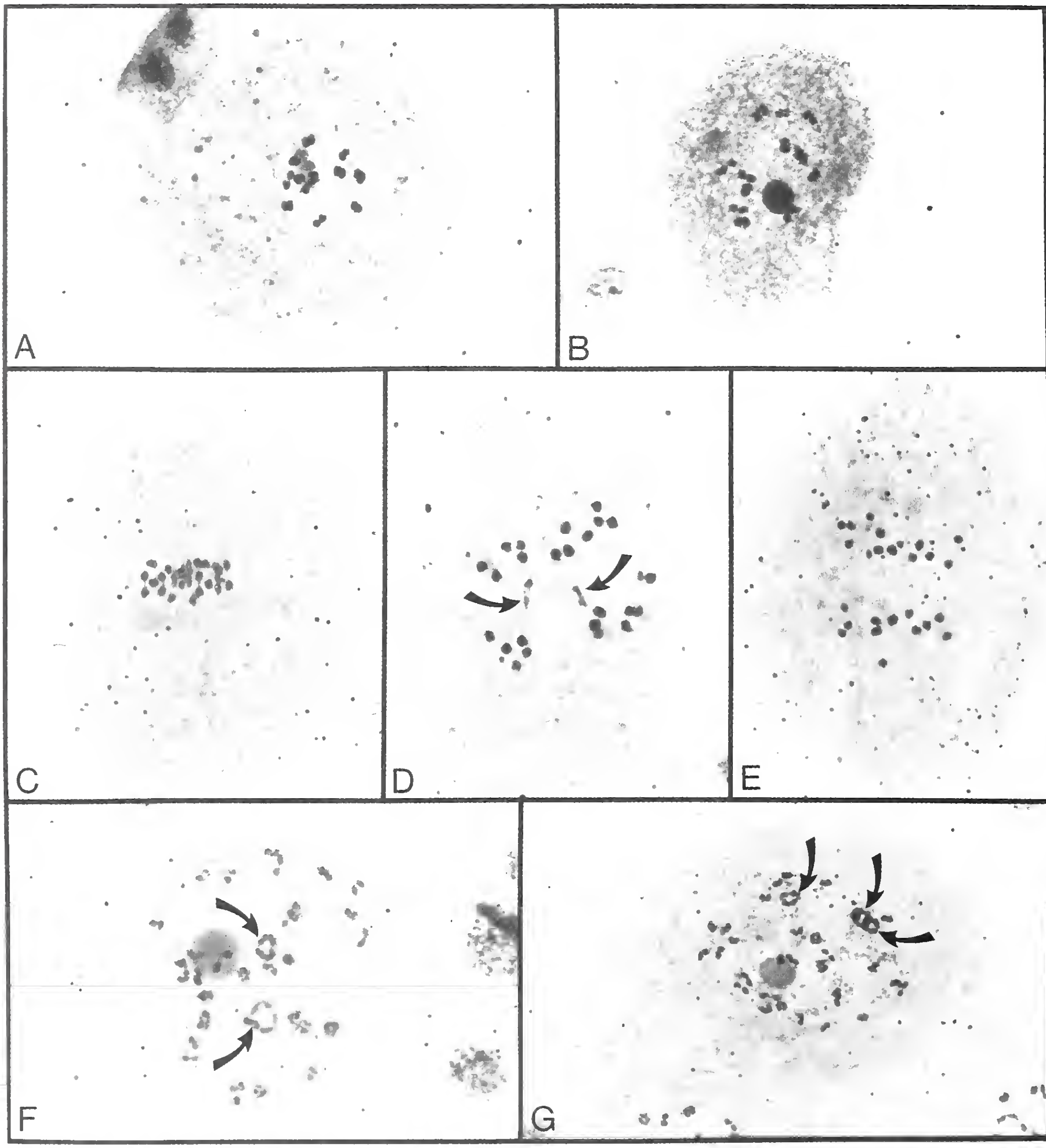

FIGURE 5.—Meiotic chromosomes in the Ramosa group. A & B: *E. ramosa* subsp. *ramosa*, *Spies 3490*, with 12 bivalents, A, early metaphase I; B, diakinesis. C–E: *E. rehmannii* subsp. *rehmannii*, *Davidse 33708*: C, metaphase I with 12 bivalents; D, anaphase I with 2 univalents dividing precociously into chromatids (indicated by arrows); E, anaphase I with unequal (12–14) distribution of chromosomes). F & G, *E. rehmannii* subsp. *subspicata*, *Spies 3515*, with 72 chromosomes which include multivalents (indicated by arrows). G, × 745; A, B, C, E & F, × 1000; D, × 1200.

up to six univalents were observed during diakineses. No laggards were observed in this specimen at anaphase I and the rest of meiosis was normal.

The only representative of the Dura group studied, was a diploid *E. dura* specimen with a B chromosome present in approximately 90% of the cells studied (Figure 6A–C). The B chromosome appears as a round, lightly stained body during diakinesis (Figure 6B). It is present in all stages and during telophase I it is excluded from the nucleus (Figure 6C).

In summary, the basic chromosome number of the genus *Ehrharta* is 12 and ploidy levels range from diploid to decaploid. Based on one earlier count for one specimen of *E. calycina* with 2n=30, Spies & Voges (1988) suggested that a basic chromosome number of six is possible. However, the current, much more extensive results, indicate that the 2n=30 plant is probably an aneuploid with six additional chromosomes. It is also interesting to note that ploidy levels exceeding tetraploidy, were restricted to the eastern part of the distribution area of the genus. Further cytogenetic studies on *Ehrharta* should include the production of artificial hybrids between the different species and meiotic analyses of these hybrids to clarify the genomic relationships in the genus.

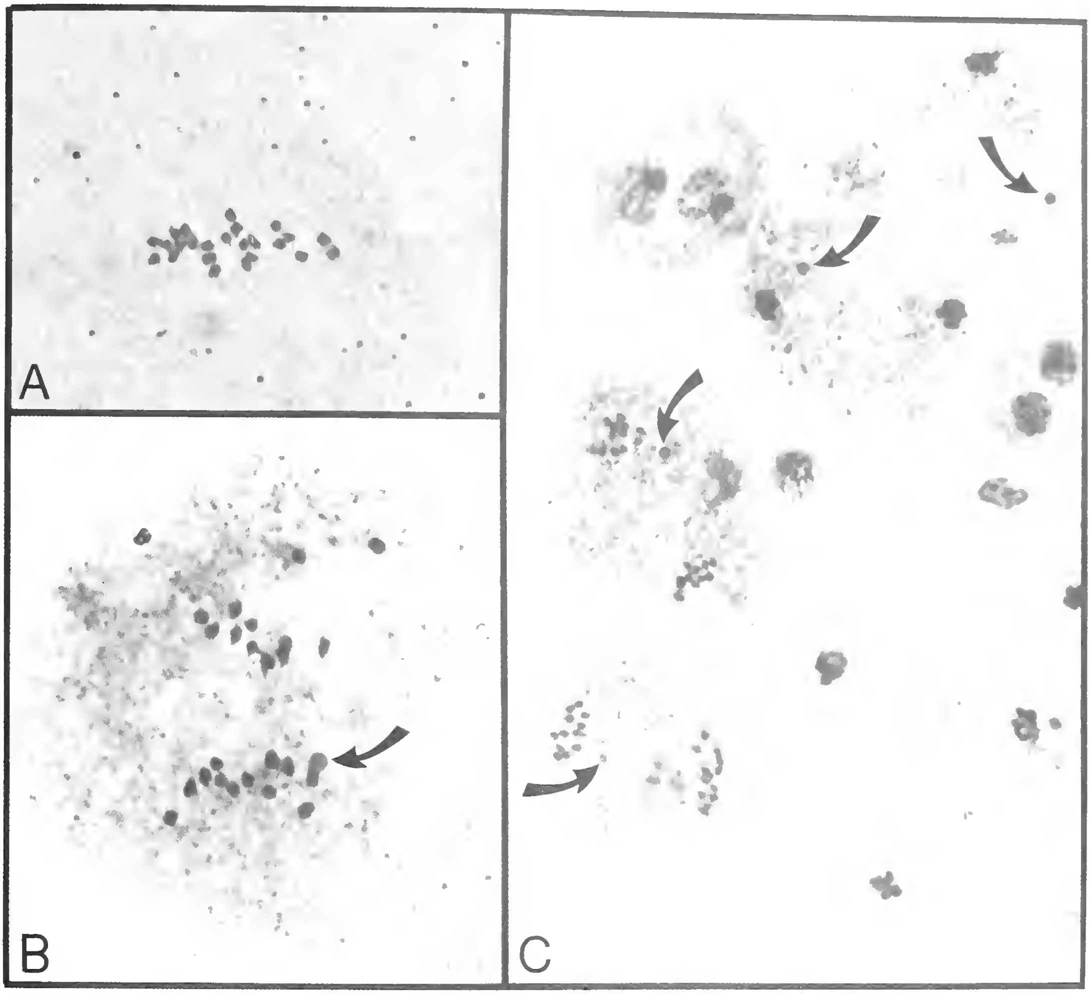

FIGURE 6.—Meiotic chromosomes in the Dura group: *E. dura*, *Davidse 33534*, with 12 bivalents and up to four B chromosomes (indicated by arrows). A, × 1400; B, × 1700; C, × 1000.

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Miscellaneous notes

VARIOUS AUTHORS

TWO NOMENCLATURAL PROBLEMS INVOLVING ARTICLE 63

While preparing a course in plant nomenclature in 1982, I endeavoured to find examples of superfluous names in South African taxonomic literature. Among others, I found the following two cases but, in the first, the rules, since the 1987 Berlin Congress, have changed to make the second option in the example a case of later synonymy rather than superfluity. However, it is such an interesting case, that it deserves mention.

1. *Silene dewinteri* or *S. constantia*?

Bocquet in *Bothalia* 12: 309–311 (1977) described *Silene dewinteri* as a new species with *Bocquet 17774* as holotype. He cited in synonymy '*S. constantia* Eckl. & Zeyh., Enum. 32 (1834) quoad descr., typo et synonymia excludendis'.

In their protologue of *S. constantia*, Ecklon & Zeyher included, in synonymy, *S. crassifolia* L. var. *angustifolia* Bartl. (1832), based on Ecklon specimen/s from the vicinity of 'uppermost blockhouse' at Devil's Peak. Bocquet in his 'Observations' on *S. dewinteri* stated that because Ecklon & Zeyher cited *S. crassifolia* var. *angustifolia* in synonymy under *S. constantia* the latter was 'automatically typified by the type of the variety'. According to Dr R. K. Brummitt of Kew, this could be construed to constitute lectotypification of *S. constantia* by the Ecklon 'blockhouse' specimen/s which, however, Bocquet referred to *S. clandestina* Jacq. However, it is not certain whether this does constitute lectotypification because, by definition (Article 7.5 of the *International code of botanical nomenclature*, 1988), a lectotype can only be a single specimen or illustration and Bocquet clearly referred to specimens (plural). Unfortunately in Bartling's description of *S. crassifolia* var. *angustifolia* there is no indication of whether the varietal name is based on one or more Ecklon specimens. I have corresponded with Mr Daniel Masson of Geneva (G), who is continuing with Bocquet's revision of the southern African species of *Silene*, to establish whether one or two specimens were involved and whether there were annotations by Bocquet on the specimen/s. In his reply (letter of 1988.10.08) Masson mentions that he has two specimens on loan from Stockholm which may be relevant. The first is an Ecklon specimen bearing the names *S. crassifolia* var. *angustifolia* (det. Bartling, 1831) and *S. thunbergiana*. No locality is given, but the label carries the number 53 which may refer to 'Stellenbosch, Houwhoeksbergen', if it relates to the Ecklon & Zeyher localities listed by Drège in *Linnaea* 19: 583–598 (1847). The second specimen, anonymous as to collector, bears three names viz. *S. flexuosa* (ined.), *S. crassifolia* var. *angustifolia* and *S. constantia*. The number 85 appears on the sheet and if it is an Ecklon & Zeyher number (as listed by Drège in *Linnaea* 20: 258 (1847), it refers to 'eastern side of Table Mountain at Constantia'. Masson identifies this specimen as *S. clandestina* and suggests that it is an Ecklon specimen. However, if the number 85 is an Ecklon & Zeyher number, then the locality is incorrect for the type of *S. crassifolia* var. *angustifolia*. The same applies to the first specimen. On the evidence available, it seems doubtful whether either specimen is the Ecklon type of *S. crassifolia* var. *angustifolia* from the 'uppermost blockhouse' at Devil's Peak. Neither specimen has been annotated by Bocquet—let alone as lectotype of *S. constantia*.

Therefore, there are two aspects to the *Silene dewinteri* versus *S. constantia* problem, one in which the lectotypification is regarded as having been effected and the other not. The two aspects will be examined in turn.

1.1 *Lectotypification effected*

This situation concerns lectotypification of *Silene constantia* irrespective of whether it is correct or not. Bocquet clearly stated that the description of *S. constantia*, but not the type, agreed with his concept of *S. dewinteri*. In short, he admitted a discrepancy or conflict between the designated lectotype of *S. constantia* and its protologue, specifically the description. What are the practical implications of these facts? Two implications come to mind: 1, if one ignores Bocquet's incorrect lectotypification of *S. constantia*, then *S. dewinteri* remains a correct name and *S. constantia* remains a synonym of *S. clandestina*; 2, if one rectifies the lectotypification, then *S. constantia* becomes the correct name and *S. dewinteri* a later legitimate synonym in the context of Note 2 of Article 63.1 (a superfluous name pre—the 1987 Berlin Congress). There is no problem in designating a new lectotype of *S. constantia*. Ecklon and Zeyher in describing *S. constantia* clearly used their own gathering *Ecklon & Zeyher s.n.*: the specimen agrees with the description and was collected near Constantia and Hottentots Holland. However, such a step, if considered advisable, is best left to someone working on the genus.

An obvious question arises. Why did Bocquet assert that *S. constantia* was automatically typified by the type of the cited synonym, *S. crassifolia* var. *angustifolia*? A possible explanation is that Bocquet erroneously invoked Article 7.11 (previously 7.9), which states that 'a *nomen novum* for an older name is typified by the type of the older name'. The way in which Bocquet phrased the typification, viz. 'typified by the type of the variety (older name*)' seems to point to this. It is doubtful whether Bocquet, in spite of possibly effecting lectotypification, deliberately intended lectotypifying *S. constantia*. Significantly, he did not use the word 'lectotypification'.

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* my parenthesis.

1.2 *Lectotypification not effected*

In this case one has the option of designating a lectotype for *S. constantia*, but this is not mandatory (Article 7.5 and Recommendation 7B). If a lectotype is designated, the *Ecklon & Zeyher* s.n. specimen mentioned above would be a good choice. The result of this action, as already indicated, would be that *S. constantia* becomes the correct name and *S. dewinteri* a later synonym.

2. *Antholyza caffra*

In a note on *Anapalina caffra* (Ker ex Bak.) Lewis in *Journal of South African Botany* 37: 235 (1971) Goldblatt states that *Antholyza caffra* Ker ex Bak. (1892) was not a superfluous name, even though the earlier *Anisanthus splendens* Sweet (1831), a misidentification, was cited in synonymy and he cites Stafleu's interpretation of the Seattle modification of Article 63 in support [see Stafleu in *Taxon* 19: 41–42 (1970)]. The Seattle modification relates to the explicit or implicit exclusion of the type of the cited name. Stafleu interprets this as follows: 'When it can be shown that the type of a cited name cannot within reason have been included by the author within the circumscription of his new taxon, his name does not become automatically superfluous on account of the mere citation of the older name'. Goldblatt writes: 'As Baker probably named this plant *Antholyza caffra* thinking that Ker's name had priority over *Anisanthus splendens* and because the latter cannot be included in Baker's circumscription of this species the question of superfluity cannot really be raised, particularly if Stafleu's interpretation of the modification of Article 63 is followed'.

Let us analyse Goldblatt's statement. Firstly, he states that superfluity is not at issue because Baker believed that *Antholyza caffra* Ker (1805) had priority over *Anisanthus splendens* (1831). But *Antholyza caffra* Ker was a *nomen nudum* and therefore not validly published. By supplying a description Baker validated the name for the first time and by citing *Anisanthus splendens* as a synonym ['the citation of the name itself' (Article 63.2)] without excluding its type either explicitly or implicitly (there is no evidence of such exclusion) the name *Antholyza caffra* becomes superfluous. Secondly, Goldblatt asserts that because *Anisanthus splendens*, as figured and described by Sweet, cannot be included in Baker's circumscription of *Antholyza caffra*, the question of superfluity cannot be raised. The fact is that whatever taxonomists of today think about the relationship between the two species, Baker himself regarded *Antholyza caffra* as conspecific with the earlier *Anisanthus splendens*. This is not surprising if, as pointed out by Goldblatt, 'the plants are similar', though they are now known to belong to different genera. Weresub & Hennebert [*Taxon* 12,6: 218–228 (1963)] would call this a case of facultative superfluity involving a facultative synonym as opposed to nomenclatural superfluity involving an obligate synonym.

Clearly there seems to have been a misinterpretation of the Seattle modification of Article 63, since the question of explicit or implicit exclusion does not arise at all. What is the implication of *Antholyza caffra* being superfluous? The name *Antholyza caffra*, being illegitimate, the epithet *caffra* can only be used in *Anapalina* if the combination *Anapalina caffra* is treated as new dating from 1960 and attributed solely to Lewis.

I thank Dr R. K. Brummitt of the Royal Botanic Gardens, Kew, for helpful comments on these two cases.

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THE CARYOPSIS SURFACE OF *PENTAMERIS* AND *PSEUDOPENTAMERIS* (ARUNDINOIDEAE, POACEAE) REVISITED

Barker (1986) reported on the structure of the surface of the caryopses of five taxa in *Pentameris* Beauv. and one in *Pseudopentameris* Conert. This study showed there to be three types of surface sculpturing (colliculate, rugose and reticulate) and three types of caryopsis shape (cuneate, elliptic and globose-truncate). Free stylar hairs were observed in all the examined taxa of *Pentameris*, where they appear as a crown of short weak hairs (see Barker 1986 for photomicrographs of these structures). These structures were, however, absent from the caryopses of *Pseudopentameris macrantha*.

Subsequent to the work of Barker (1986), Clayton & Renvoize (1986) have defined the fruit of *Pentameris* as an achene, while that of *Pentaschistis* Stapf is considered to be a caryopsis. This difference is recognized, and the term caryopsis is used here in the broad sense, as advocated by Sendulsky *et al.* (1987).

The caryopsis of *Pseudopentameris brachyphylla* was predicted by Barker (1986) to have a narrowly elliptical shape, reticulate surface sculpturing and no free stylar hairs. The caryopsis of *Pentameris longiglumis* was expected to have an elliptic shape, colliculate surface features and free stylar hairs.

This study was carried out to test these predictions, and to augment the data on caryopsis structure in the southern African Arundineae.

MATERIALS AND METHODS

Caryopses were obtained from herbarium specimens housed in the National Herbarium, Pretoria (PRE). They were gold-coated after being mounted on stubs using two-sided sticky tape. Specimens were examined using an ISI-SX-25 Scanning Electron Microscope. Photographs were taken using Tura 60 × 70 mm format black and white 100 ASA film.

Specimens examined:

Pentameris longiglumis

CAPE.—3318 (Cape Town): Table Mountain (—CD), *Marloth 3078*.

Pseudopentameris brachyphylla

CAPE.—3419 (Hermanus): Die Mond se Kop (—AD), *Barker 58*.

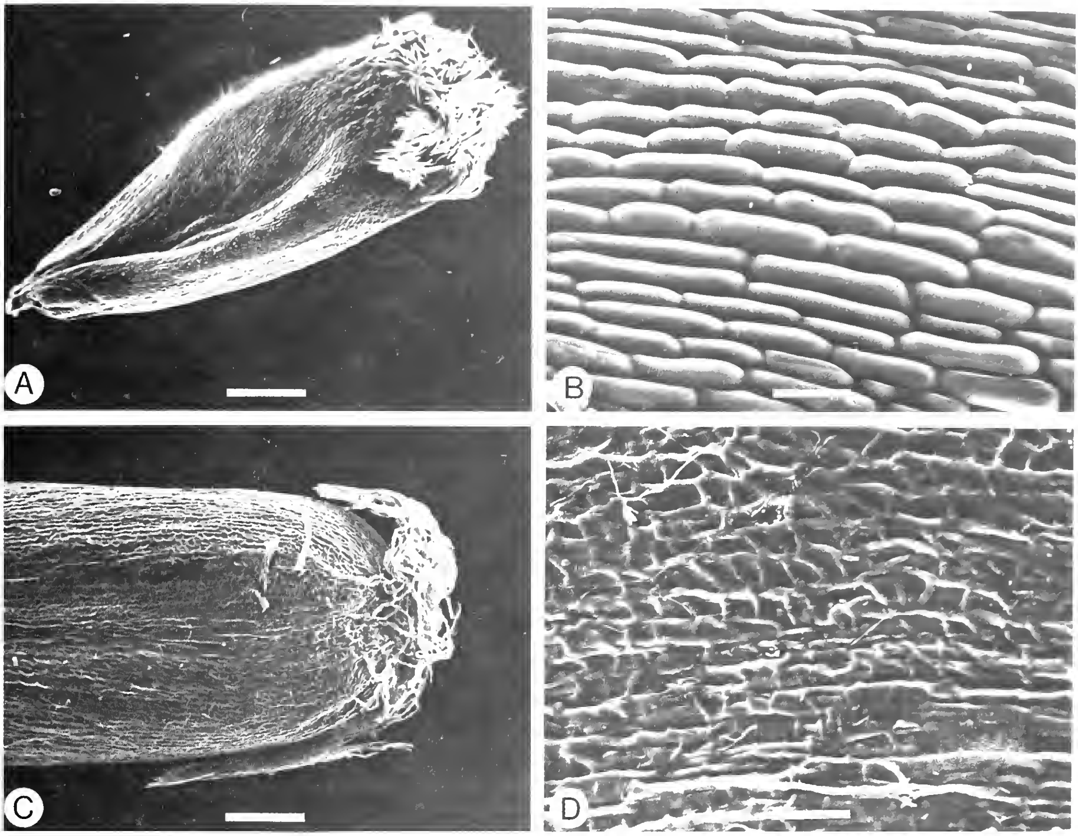

FIGURE 1.—A & B, *Pentameris longiglumis*, *Marloth 3078*: A, slightly malformed caryopsis, with colliculate sculpturing and free stylar hairs, scale bar = 450 μ; B, close-up of colliculate sculpturing, scale bar = 40 μ. C & D, *Pseudopentameris brachyphylla*, *Barker 58*: C, stylar end of caryopsis, note the reticulate sculpturing, linear-elliptical shape and absence of stylar hairs, scale bar = 420 μ; D, high magnification of reticulate sculpturing, scale bar = 155 μ.

RESULTS AND DISCUSSION

The morphology of the caryopses of these two taxa corroborate the predictions made in an earlier publication (Barker 1986). Figure 1A shows the entire caryopsis of *Pentameris longiglumis*. Although slightly malformed, it is basically elliptical in shape, and the surface is of a colliculate nature (Figure 1B). This structure compares closely with those of the previously examined *Pentameris obtusifolia*, *P. macrocalycina*, and to a lesser extent, *P. thuarii*, in that the former two species have elliptical caryopses with colliculate sculpturing and free stylar hairs (Barker 1986), while the latter species differs only in having a globose-truncate caryopsis.

The caryopsis of *Pseudopentameris brachyphylla* is, as predicted, narrowly elliptical and reticulately sculptured, with no free stylar hairs. Figure 1C shows the distal or stylar half of the grain. The remains of the style and style base may be seen, but the small weak hairs, which are obvious in *Pentameris longiglumis*, are lacking. Figure 1D shows the reticulate nature of the surface of the caryopsis. The caryopsis of this species is visually indistinguishable from that of the previously examined *Pseudopentameris macrantha*.

Both species examined here are rare, and only a few herbarium specimens were available. The small sample size may be construed as inadequate, especially since the caryopsis of the *Pentameris longiglumis* specimen is slightly malformed. However, the results obtained confirm the predictions made previously (Barker 1986), and a complete character set for all presently known taxa in both genera is now available. These data are outlined in the character by taxon matrix (Table 1) which is an update of the table published earlier (Barker 1986).

Further work on *Pentaschistis*, *Pentameris* and *Pseudopentameris* is in progress (Barker in prep., Linder pers. comm. and Ellis pers. comm.), which will throw further light on the taxonomy and phylogeny of these related genera.

CONCLUSION

Species of *Pentameris* have elliptic or globose caryopses with colliculate sculpturing and free stylar hairs, whereas the species of *Pseudopentameris* have narrowly elliptic caryopses, reticulate surface features and no free stylar hairs.

This study has provided additional information and improved the understanding of the variation within and between the genera *Pentameris* and *Pseudopentameris*. The taxonomic importance of characters such as the presence or absence of free stylar hairs, has been reiterated.

TABLE 1.—Caryopsis characters for all species in the genera *Pentameris* and *Pseudopentameris* (updated from Barker 1986)

Species	Shape of caryopsis			Surface of caryopsis			Style hairs	
	Cuneate	Elliptic	Globose	Colliculate	Reticulate	Rugose	Absent	Present
Pentameris								
thuarii			x	x				x
dregeana	x					x		x
macrocalycina		x		x				x
obtusifolia		x		x				x
sp. nov.		x			x			x
longiglumis		x		x				x
Pseudopentameris								
macrantha		x			x		x	
brachyphylla		x			x		x	

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OBITUARY

RUDOLF GEORG STREY (1907–1988)

Rudolf Georg Strey (Figure 1) was born in Templin in the Uckermark region north of Berlin, Germany, on the 28th of April, 1907. His father, Wilhelm Georg, was a pharmacist with a concession for the only pharmacy in a town of some 7 000 inhabitants. Wilhelm Georg later took over his brother's pharmacy at the outbreak of the First World War, in Stettin, and Strey attended school there at the Friedrich-Wilhelm Gymnasium from 1914 to 1918. In 1916 Strey's father rented the Adler Pharmacy in Angermünde in Neumark, halfway between Stettin and Berlin, and Strey completed his schooling at the Uckermärkische Real-Pro Gymnasium, in Angermünde, from 1918 to 1923.

Strey was the second son by two years, and as the tradition was at the time, the first son followed the father's profession and the second son was sent to study agriculture. Strey attended a number of agricultural institutions between 1923 and 1928, in Genschmar im Oderbruch, at Gross Lubras in West Havelland, at Gross Santersleben in the Magdeburger Börde, and finally at Graeningen near Rathenow where his father had opened the Grüne Pharmacy after the war. In 1927–1928 he went to an agricultural college, the Höhere Lehranstalt für Praktische Landwirte in Potsdam, and qualified with the diploma 'Staatlich geprüfter Landwirt'.

Owing to the depression and devaluation of the currency in Germany after the war, and the Wall Street disaster, Wilhelm Georg offered his son a passage to one of the German colonies where his prospects would be better. Strey sailed for Cape Town and arrived in South West Africa in October 1929. He became apprenticed to A. Stauch, a diamond merchant, to work on his farm Dordabis, and it was here that he met his first wife on the neighbouring farm Ibenstein. Shortly afterwards Stauch's business went bankrupt and Strey attended a course on karakul breeding at Neudamm Agricultural College near Windhoek.

Strey's father and uncle came out to SWA in 1930, and Strey started on his own on the government farm Buellspoort No. 172 District Rehoboth, near the Naukluftberge. His father helped him buy the farm, but he stayed only a short while before returning to Germany. The farm proved profitable for dairy cattle until the big drought of 1933, after which Strey switched to farming with grey and black karakul. During this period he became seriously ill with a combination of Malta fever, amoebic dysentry and malaria, and he returned to Germany to the Tropen Institute Tübingen for treatment.

Strey developed an interest in botany because, as a farmer, he wanted to know the plants that were either palatable or poisonous to his stock. As there was little literature available he made efforts to consult various botanists. Dinter visited him at Buellspoort in December 1934 and he also met Prof. O. H. Volk and E. B. Schoenfelder. In 1940 Strey was interned, first at Baviaanspoort and Koffiefontein, and later he was sent to the Andalusia Internment Camp at the present Jan Kempdorp, near Warrenton, in the N Cape. A number of visiting German botanists were also caught by the war, and Prof. Volk, Dr Mueller-Stoll, Dr Rehm and Dr Cloos started a University-type botany course in the camp. With the help of other scientists, this course started in 1940 and lasted until 1946. Students were examined regularly and after the war the German universities acknowledged the course. Other lectures on poisonous plants, ecology, pasture management and indigenous plants interested many of the farmers.

Strey built up a new Index of SWA plants, at the suggestion of Prof. Volk, and he combined the names from Dinter's index with Range's Flora and the herbarium lists of Schoenfelder and Rusch. He then started a card index for all correct plant names with information on literature, synonyms, types and voucher collections. During this time the whole of Phillips' *Genera of South African Flowering Plants* was translated into German. Strey's index is housed at PRE, along with his indexes of collectors, localities and botanical literature relating to SWA.

On his 37th birthday, towards the end of the internment, Strey was presented with the following eulogy which is framed and housed in the Natal Herbarium museum:

Streyina aculeata spec. nov. unica.
(post annos 37 in captivitate se evolutans)

Discipulus scientiae amabilis; altus agilisque, perfectae, fere patientiae, sed non raro distincte mucronatus.

FIGURE 1.—Rudolf Georg Strey (1907–1988).

Initiator collectionis magnae cartarum; colonus, copias magnas ovium cultivans, sed magno suo amore versans in regno variegato vegetabiliorum; omnes determinandi difficultates facillime superavit.

Habitat: in desertis extremis africae austro-occidentalis, in Porta Taurina.

Coelesti dent ei mox libertatem, vitam longam luxurians et multos successus.

Deterunt Andalusiae: ante diem quartam Calendas Majas anno Domini 1944.

Signed by O. Volk, H. Herre, A. Giess[?], Matz, Gunter, Kalun etc.

Loosely translated this means:

Streyina aculeata, a unique new species
(developing in captivity after 37 years)

A disciple of the amiable science [botany]; tall and agile, well built, usually of perfect patience, but not rarely distinctly pointed.

Initiator of a large collection of cards; farmer, cultivating great quantities of eggs, but avidly studying the many-faceted plant kingdom; he overcame all difficulties of identification most easily.

Habitat: in the extreme desert of South West Africa in Buellspoort.

May the inhabitants of heaven soon grant him freedom, a long luxurious life and many successes.

Signed in Andalusia: 28.4.1944.

After internment he was released to Stellenbosch where he stayed for a few months with H. Herre, who had resumed curatorship of the Stellenbosch University Botanic Garden. Strey worked at the gardens and in the herbarium of the University with Dr Rehm.

At the end of November 1946 he returned to Buellspoort. Due to ill health, but also because of his new and different interests, he gave up farming. He started collecting from all parts of the country, sending his plants for identification to Kew, Munich, Kirstenbosch (National Botanic Gardens) and Pretoria (Botanical Research Institute). Bulbs, seeds and succulents were sent to Herre in Stellenbosch. Buellspoort became a well known type locality for plants and insects. Strey was a keen insect collector, gathering the first blind beetles from the Namib. He has a number of beetles and moths named after him by Dr Koch and Prof. Janse of the Transvaal Museum. He also collected fungi which are mainly deposited in PREM.

He continued compiling the indexes of SWA collectors, literature, place names and maps, but his chief interest between 1947 and 1952 was archaeology. This was principally because of his association with the renowned Abbé H. Breuil, an expert in palaeolithic archaeology, who is perhaps best known for his studies in cave art. Breuil occupied a chair at Witwatersrand University from 1944 to 1951, and he made three important trips to SWA between 1947 and 1950. Strey guided and helped organize these trips and together with Dr Scherz and others they explored, recorded and mapped prehistoric sites in SWA and the northern Cape. A cave in the Erongo Mountains is named after him. Strey also led an expedition to the Okavango with Dr Gusinde from America, in 1950, to study the Taung bushman tribe.

His collections of rock paintings, stone implements and other museum pieces are housed in the Windhoek Museum, the Swakopmund Museum and in the archaeological collections of the Witwatersrand University. Strey met his second wife on one of the expeditions with Breuil. She worked as an artist with the group reproducing various paintings, including many details of the White Lady shelter in the Brandberg. An article by her (Rita G. Strey 1962) provides a fascinating insight into these excursions.

Strey sold the farm Buellspoort in 1950, and he travelled and organized expeditions until going up to Pretoria in 1953. He obtained employment working for a small printing press, eventually buying his own press in Germiston. On 17.2.1955 Strey was appointed as a technician to the Botanical Research Institute in Pretoria, to work in the National Herbarium.

In 1961 he produced a manuscript on ‘Two hundred years of Botanical Research in South West Africa’ which was the culmination of his earlier research. This gives an outline of the history of botany in SWA, divided up into periods, with the main collectors listed and the herbaria in which the collections are housed. The literature of special interest to SWA botany is recorded, including maps, ecology, physiology, medicinal and poisonous plants. Strey also described a species of *Cucumis* with A. Meeuse (Meeuse & Strey 1962). This is now a synonym for *Cucumella bryonifolia* (Merxm.) C. Jeffrey.

He worked in Pretoria for seven years, living on a plot in Silverton where he also bred chickens. In April 1962 he was transferred to Natal Herbarium in Durban where he became curator and later officer-in charge of the Botanical Research Unit.

His years in Natal marked the scientifically most active phase of his career. He revitalized and re-organized Natal Herbarium, building up a fine museum with early memorabilia from Medley Wood, and own collections of insects, wood, fruit and seeds. Strey developed the herbarium garden, planting large numbers of rare Natal plants. He realized that before Bews’s *The Flora of Natal and Zululand* (1921) could be revised, a considerable amount of collecting was necessary to fill in the gaps. He collected from as wide an area as possible since many species were known from only a few specimens, and his collecting numbers which started at 4150 when he arrived in Durban, reached 11300 by the time of his retirement. Reference to Ross’s *Flora of Natal* (1972) bears witness to the effective and untiring work of this dedicated collector.

Strey also made a point of visiting type localities of rare or once-collected Natal plants. His relocation of *Elephantorrhiza woodii,* not collected since the Medley Wood type from near Colenso, allowed J. H. Ross to emend Phillips’s earlier description of the habit of the species when Ross revised *Elephantorrhiza* in 1974. This was possible because Strey succeeded in cultivating the species at Natal Herbarium.

His earliest research at Natal Herbarium, concerned the genus *Dietes* in 1965, and his notes, dissections of petals and boxes of fruit and seeds are housed in PRE. He then took considerable interest in palms, particularly *Hyphaene* and *Raphia.* The latter resulted in his describing a new species with Mrs A. A. Mauve (Obermeyer & Strey 1969).

Strey concentrated particularly on the rich flora of the sandstone areas of southern Natal and Pondoland, with

its many endemic species. He often collected with Mr H. B. Nicholson of Skyline, St Michael's-on-Sea, and together they worked the region intensively. His publications arising from this activity are Strey & Leistner (1968) and Strey (1972). *Barringtonia racemosa* drew his attention and was written up for the *Flowering Plants of Africa* (Strey 1973a).

Strey developed a great interest in the family Araliaceae and his intensive research on *Cussonia* gave rise to the following publications: Strey 1973b, 1975, 1981. His original research in the Araliaceae also contributed to, and was acknowledged in Burtt & Dickison 1975.

Plant species names which commemorate Strey are *Pseudosalacia streyi* Codd (Celastraceae), *Crassula streyi* Toelken (Crassulaceae), *Sonderina streyi* Merxm. (Apiaceae); *Piaranthus streyianus* Nel (Asclepiadaceae), *nom. nud.* and now a synonym for *Orbea rangeana* (Dinter & Berger) Leach; *Lithops streyi* Schwantes (Mesembryanthemaceae), now a synonym for *L. gracilidelineata* Dinter [although this is not cited in the new *Lithops* book by Desmond T. Cole (1988).]; *Lapeirousia streyi* Suesseng. (Iridaceae), now a synonym for *L. caudata* Schinz subsp. *burchellii* (Bak.) Marais & Goldblatt; *Turraea streyi* F. White & B. T. Styles (Meliaceae); *Anthospermum streyi* Puff (Rubiaceae); *Indigofera streyana* Merxm. (Leguminosae), now *I. hochstetteri* Bak. subsp. *streyana* (Merxm.) A. Schreib. and *Indigofera herrstreyi* (my manuscript name).

Besides his published research, Strey built up very comprehensive biographical notes on early Natal botanical collectors, in particular M. J. McKen, J. Medley Wood and Wilhelm Keit. Most of his notes, accumulated during many hours of research in museums and libraries in South Africa and Europe (particularly on one overseas trip in 1978), are housed either at the Killie Campbell Museum or the Natal Herbarium in Durban.

Strey retired at the end of April 1972, but was re-employed for a further three years, until the end of 1975, before retiring permanently to his cottage at the Village of Happiness, near Margate. He remained actively interested in *Cussonia*, growing a fairly representative collection of species around his home. Today his cottage can still be easily singled out from a distance, as it is surrounded by these distinctive plants. Rudolf Georg Strey died peacefully on the 30th of June 1988 and was cremated according to his wishes. He leaves two daughters and a son by his first marriage, and one daughter by his second marriage.

ACKNOWLEDGEMENTS

I would like to thank the following very much indeed for all their help in providing certain details: Mr Rolf Strey, Miss R. Williams, Mrs H. E. Noble, Mr H. B. Nicholson and Dr O. A. Leistner, and Dr H. Glen for the Latin translation.

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B. D. SCHRIRE

Book Reviews

COMBRETACEAE IN SOUTHERN AFRICA by J. D. CARR. 1988. *Tree Society of southern Africa,* P.O. Box 4116, Johannesburg 2000. Pp. 236. Price R55,00 + GST.

This book covers the six genera which occur in South Africa, SWA-/Namibia, Botswana, Swaziland and Zimbabwe. Unrest precluded the inclusion of Angola, Zambia and Mozambique, but the author mentions for each species whether records exist from regions he was unable to work in.

Carr's book is a practical 'field identification guide based on certain fruit characters, with species separated first of all by mature bark pattern and then by reference to habit, habitat, average leaf size and flowering period—in that order—followed by maximum and then average dimensions of fruit'. The author's descriptions of the plants are mainly compiled from live material in the field but he used herbarium material in order to account for variation within the species.

A key for the six genera is provided but, because four of the six are represented by only one or two species in the region, the author excludes them from the specific guides for *Combretum* and *Terminalia*.

Carr describes each species in great detail. He provides synonyms, common names, national tree numbers, as well as distribution maps (with arrows indicating points on the map too small to shade). He also provides geographical information in the form of regions and place names. He then discusses the habit, habitat, bark, foliage, inflorescence, fruit and propagation and cultivation. Aside from the colour plates by Elise Buitendag in the front of the book, the author provides a full set of black and white photographs for each species. These photos usually include the habit, inflorescences, fruit, the seedling and variation of bark patterns.

I tested the key using two people who had little knowledge of the Combretaceae with specimens found in the garden. Five out of seven species were identified quite easily and the other two required some prompting.

Problems experienced were: (a) the key only provides the species name and not the page on which the species description occurs. However, the author has arranged the genera and species in alphabetical order, which helps to overcome this irritation; (b) the glossary is incomplete; terms unfamiliar to non-taxonomists such as arcuate, reticulate and caducous, although found in the text, are not in the glossary; (c) the use of the length of fruit for initial differentiation of species caused some confusion. Carr divides the species with a 4-winged fruit into three groups: 1, up to 25 mm long; 2, up to 40 mm long; 3, up to 77 mm long. The reader must realise that if the fruit of his specimen is 25 mm long, it does not necessarily fall into group 1. A fruit which is 60 mm long, however, can obviously only belong to group 3.

Apart from the minor irritations I have mentioned, this book is of tremendous value not only to botanists who have to identify plants in the field and horticulturists who need to know more about the propagation and cultivation of these indigenous plants, but also to laymen who want to know more about our flora.

From an ecologist's point of view this key is of immense value. The author uses characters which are available at all times, with possible exception of fruit, and his detailed habitat and distribution data are also a great help. He covers the variation within a species admirably.

Denzil Carr has spent 12 or more years working on this book, travelling extensively, using his own funds, to produce field notes on each species in its natural habitat. He can, in my opinion, feel well satisfied with his latest labour of love.

M. D. PANAGOS

SOUTHERN AFRICAN BOTANICAL LITERATURE 1600–1988 SABLIT compiled by A.S. KERKHAM. *South African Library,* P.O. Box 496, Cape Town, 8000. Pp.256. 16 plates. ISBN 0 86968 083 8. Price R35,00 + GST.

This book, *Southern African botanical literature* (SABLIT), began as a revision of *Flora africana,* a work little known among South African botanists, compiled in 1963 by W. Tyrrell-Glynn with the assistance of M. R. Levyns in commemoration of the 50th anniversary of Kirstenbosch. With the 75th anniversary celebrations taking place in 1988, the South African Library (SAL) offered to produce a revised version. This involved more work than was first envisaged and several important national bibliographies had to be consulted. The coverage of *Flora africana* was 1600–1963 and included only South Africa. The coverage of SABLIT has been extended to 1988 and includes southern Africa 'on a selective basis'—unfortunately not defined, but obviously including the RSA, Lesotho, Namibia, Swaziland, Zimbabwe and Malawi, but excluding Mozambique and Botswana. The original *Flora africana* was a selective bibliography based solely on the SAL collection. This is not the case with SABLIT: coverage has been widened and major library collections have been consulted. The present bibliography has been brightened by the inclusion of 16 colour plates intended to show the development of botanical illustration. An additional plate, representing '*Oxalis speciosa*' from Jacquin's *Oxalis* (1784) appears on the outer front cover.

In the foreword it is stated that the bibliography 'is not intended to be a masterpiece of bibliographical research, as detailed bibliographic information of that nature is already available in F.A. Stafleu's (& Cowan's!) multivolume *Taxonomic literature*.' It should be pointed out that *Taxonomic literature* (1976–1988) covers the period 1753–1940, whereas SABLIT purports to cover the period 1600–1988 i.e. there is a 201-year difference in coverage between the two bibliographies. Furthermore, *Taxonomic literature* includes only authors who have published at least three generic names. This automatically excludes scores of southern Africa authors, especially non-taxonomists. The point being made is that coverage of southern African literature in *Taxonomic literature* is limited, because of the time period and generic name criteria applied.

In the introduction the compiler, A.S. Kerkham, describes the items included in SABLIT. The main items included are literature references dealing with botanical history, taxonomy and ecology, but excluding horticulture, plant anatomy and physiology. Manuscripts, theses, journal articles, textbooks and juvenile books have been excluded. Certain exceptions have been made where information in, say, a journal or thesis is considered to be of a particular botanical interest.

The bibliography proper is preceded by an account of South African botany (note: not southern African botany) with particular reference to historical background and botanical illustration. In the foreword it is said that this account is based on a paper delivered at Bibliophilia Africana, the 4th South African Conference of Bibliophiles held in September 1981. Unfortunately, the author of this paper is not revealed, consequently the paper is not cited in the references used.

This historical account obviously derives much of its content from previous works, such as Phillips (1930), Levyns (1970–1976), Dyer (1977) and Gunn & Codd (1981) and is a concise, readable essay, but it should not have been entitled 'South African Botany', since it is restricted to works dealing with the flora and excludes vegetation. In the discussion of Recent Publications a very notable omission is the *Flora of southern Africa* (FSA) launched in 1963 to replace the now outdated *Flora capensis* (1895–1933). In the *FSA* series 24 volumes or parts thereof have been published so far. Surely this definitive work warrants inclusion rather than some of the somewhat light-weight works included in the account. Another comment on Recent Publications. The compiler has been brave enough to single out a certain artist as 'currently South Africa's leading botanical artist'. As editor of *The Flowering Plants of Africa* for 15 years, I have had a lot to do with botanical art and botanical artists but, in spite of this, I would not have the temerity or presumption to choose South Africa's leading botanical artist. The situation is that there is such a wealth of talent in botanical art in the RSA at present, that it would be extremely difficult if not impossible to designate any one artist as the best in the field.

The compiler also pronounces judgement on the scientific merit of one of the publications, namely Auriol Batten's *Flowers of southern Africa* (1986). He describes it as 'not necessarily a work of any great scientific value'. Admittedly the text is written primarily for the layman and is not a taxonomic treatise, but the paintings, as admitted by Kerkham, are of a very high standard and represent extreme scientific accuracy. Surely this contributes to its scientific value. To single out this work as of little scientific value and not some of the very obvious coffee table books which he cites is, to my mind, rather unfair.

The bibliography is divided into two parts, viz. monographs (pp.33–213) with 753 items and serials (pp.214–224) with 64 items. I shall consider monographs first. The very first item, 001 Acocks, John

Phillip Harrison, *Veld types of South Africa* (1953), probably the most quoted botanical work in the RSA, contains one error and one omission. The error is in the spelling of Acocks's third given name: it should be Harison and not Harrison. The omission, surprisingly, is mention of the accompanying veld type map, which is possibly consulted more than the text. Item 002, the revised edition of the memoir, fortunately, includes the map.

A considerable number of items have been omitted from the monograph section. Some that immediately come to mind are: Bews, *The world's grasses* (1929), E.P. Phillips, *An introduction to the study of South African grasses* (1931) and, more recently, Werger (ed.), *Biogeography and ecology of southern Africa*, Vols 1 & 2 (1978), Stirton (ed.), *Plant invaders, beautiful but dangerous* (1978), Farr, Leussink & Stafleu's *Index nominum genericorum plantarum*, 3 volumes (1979), the extremely important work by White, *The vegetation of Africa* + AETFAT/UNSO vegetation map of Africa (1983) and Reid & Dyer, *A review of the southern African species of* Cyrtanthus (1984).

In the introduction it was mentioned that in the bibliography, theses and journal articles have been excluded unless of particular botanical value. The assessment of botanical value has presumably been made by the compiler. The result is that scores of theses and journal articles of undeniable botanical value have been excluded—works of no less merit than those included. Such theses include Irvine, *The major veld types of the northern Transvaal and their grazing management* (1941), Van der Schijff, *Ekologiese studie van die flora van die Nasionale Krugerwildtuin* (1958) and Grunow, *Objective classification of plant communities: a synecological study in the sour-mixed bushveld of the Transvaal* (1965).

Regarding journal articles, four of Bews's articles have been included, but what of the remaining 25, all of a high standard? A significant omission is E.P. Phillips, A contribution to the flora of the Leribe Plateau and environs, with a discussion on the relationships of the floras of Basutoland, the Kalahari and the south-eastern region [*Annals of the South African Museum* 16: 1–379 (1917)]. Another is Henkel, Ballenden & Bayer, An account of the plant ecology of the Dukuduku Forest Reserve and adjoining areas of the Zululand coast belt [*Annals of the Natal Museum* 8: 95–126 (1941)]. Finally, Edwards, A broad-scale structural classification of vegetation for practical purposes [*Bothalia* 14: 705–712 (1983)] has had considerable impact in local ecological circles in recent times.

In a bibliography of this kind, one does not expect to find personal assessments of botanical works by the compiler. For example, under item 722 Wendland, Johann Christoph, *Collectio plantarum ... earum*, (1805–1819), was it necessary to say 'Tolerable figures of many Cape plants' and under 600 Scott, Charles L. *The genus* Haworthia *(Liliaceae): a taxonomic revision* (1988), was it necessary to state, 'A controversial revision'? Out of 753 items, these two books seem to be the only ones in the monograph section singled out for this sort of comment.

Omissions have been referred to, but unnecessary inclusions also deserve comment. Examples include items 303 and 304, International Botanical Congress, Paris 1867 and Sydney 1981 respectively. The 'laws' adopted at these congresses are international in character and applicability and do not really form part of southern African botanical literature. However, in the latter case (304) inclusion is probably justified because names of southern African plants are included in the *Nomina generica conservanda et rejicienda* and *Nomina familiarum conservanda* in the appendices. But why, if the codes are considered part of southern African literature, are only two codes included, when there have been many between 1867 and 1988?

There is little to say about the serial section except that several serials have been omitted, for example *Koedoe, Lammergeyer, Proceedings of the Grassland Society of southern Africa* and the new *Euphorbia Journal* (1983—).

Typographical errors do occur, for example *Brabeium* instead of *Brabejum* on p.16, Reynold's instead of Reynolds's on p.27 and M. Boulton instead of M. Bolton on p.47. Another thing noticed is that the location of the items is not always complete: it is clear that the BRI Library has not been fully consulted and is therefore not cited under many of the items.

The book is of A5 size with a glossy soft cover and runs to 256 pages. It is published by the South African Library and costs R35 + GST. The book will undoubtedly be of use to practising botanists for reference purposes, as long as they do not expect to find everything they are looking for. It is to be hoped that in future editions the input from knowledgeable botanists will be greater. The purpose of the book is commendable, but unfortunately the product leaves much to be desired.

D. J. B. KILLICK

THE BANKSIA ATLAS, Australian Flora and Fauna Series No. 8, edited by ANNE TAYLOR and STEPHEN HOPPER. 1988. *Australian Government Publishing Service*, G.P.O. Box 84, Canberra ACT 2601, Australia. Pp.257.

The Banksia Atlas is a profoundly important pioneering work. Although it has a line of forerunners it is unique in several significant respects. It provides for the first time, at fine resolution, distribution maps (with accompanying habitat and other data) of each species of a diverse plant genus, in relatively undisturbed country, on a continental basis.

The project was undertaken, and the Atlas produced, with the specific intent of evaluating the feasibility, and exploring the methodology, of producing a plant distribution atlas at an Australian-wide level based on a fully computerized data set derived from sight records provided entirely by volunteer contributors. The three year project was an eminent success and will hopefully provide the stimulus for a succession of similar programs not only in Australia but throughout the world.

Banksia was an ideal choice for this atlas. With its 75 species, it is diverse but yet manageable; it is taxonomically well studied and the diagnostic characters of the species are clear; it is a distinctively Australian native plant occurring in all the states and has strong aesthetic appeal.

The published volume, though not particularly attractive such as might catch the public eye, is an admirable production that is clearly and systematically layed out and easy to use. The history, aims, methods and results of the project are described in a 60-page introductory section, and this is followed by a double-page spread devoted to each species.

For each species there is a distribution map with longitude/latitude point locations based solely on sight records, together with an inset map showing the occurrence as known from herbarium specimens. The greatly expanded knowledge of distributions is clearly evident. Accompanying the maps are data on population sizes, plant form, times of flowering and new shoot growth, response to fire, possible pollinators, conservation status and a general discussion.

The data derives from 12 991 field record sheets received from 421 contributors from all walks of life and from across the land. The number of sheets sent in by contributors ranged from one to over 1 000. Around half the individuals sent in 10 or fewer record sheets, whilst just 15 % sent in more than 50. The record sheets were designed for computerized storage and manipulation and the double-page spreads were set directly from this data set.

The immediate spin-off from the project included new taxonomic discoveries and the highlighting of taxonomic problem areas, as well as increased knowledge of distributions, habitat, pollinators, conservation status, and variation within populations. Longer term returns will no doubt manifest themselves in diverse and possibly unexpected ways.

The most eloquent precursor to the *Banksia Atlas* is the *Atlas of the British flora*, edited by Perring & Walters (1962). This work covered all the indigenous and naturalized plants of Britain, totalling some 1 700 species. A 100 % sampling and plotting density on a 10 × 10 km grid (3 500 cells) was achieved. Some 1 500 of the country's botanists, professional and amateur, were involved in the collection of field records over a period of five years. The atlas does not include habitat or abundance data, but does include a series of loose overlays showing such regional aspects as geology, rainfall and land-use.

The most obvious difference between the British and Australian atlases lies in the meaning behind the distribution patterns. Those of Britain can bear little resemblance to the original natural condition, whereas those of Australia probably remain more or less true to the situation before the arrival of European man. The British Isles include an area but a tiny fraction of that of Australia, but support a human population some four times larger. Agricultural and industrial man has wrought havoc in Britain for several thousand years and in Australia for only two hundred.

The latest crop of Nobel Prizes have gone to research on fundamental subatomic particles, on the precise atomic structure of photosynthesising molecules, and on certain drugs that are finely tuned to home in on cancerous cells. Wonderful research, but it can wait. The native animal populations and vegetation of the world cannot wait. They are being eradicated at a catastrophic rate. There is mounting

evidence that massive global extinctions have punctuated earth history at roughly 30 million year intervals—caused possibly by outsized meteorite impacts. There is rapidly mounting evidence also, that unless man shifts his priorities radically, and literally overnight, he will be the direct cause of a global extinction event more thorough than any previously felt.

The selection of *Banksia* for this seminal work is fortuitous also for historical reasons. The genus was named after Sir Joseph Banks (1743—1820), who holds legitimate claim not only to the title of father of Australian naturalists, but also to the nation itself. He accompanied Captain Cook, as naturalist, on his first expedition to the Pacific and, being a man of great independent wealth, paid for all his own equipment as well as for an assistant (Solander, a student of Linnaeus) and four artists. The expedition landed in Botany Bay (near todays' Sydney) in 1770, and here Banks had an unparalleled opportunity to explore the wholly unknown flora and fauna. It was largely through his efforts in later years that the first colonies were established in Australia. His prestige back in England, where he held the Presidency of the Royal Society for a record tenure of 41 years (1778—1820), was without check.

What better beacon, naturalist's torch, than *Banksia* to help light the way towards a new consciousness of our precarious, fragile biosphere.

J. M. ANDERSON

Guide for authors to Bothalia

This guide is updated when necessary. The latest version should therefore be consulted.

Bothalia is named in honour of General Louis Botha, first Premier and Minister of Agriculture of the Union of South Africa. This house journal of the Botanical Research Institute is devoted to the furtherance of botanical science. The main fields covered are taxonomy, ecology, anatomy and cytology. Two parts of the journal and an index to contents, authors and subjects are published annually.

EDITORIAL POLICY

Bothalia welcomes original papers dealing with flora and vegetation of southern Africa and related subjects. Full-length papers and short notes, as well as book reviews, are accepted. Manuscripts may be written in either English or Afrikaans.

Articles are assessed by referees, both local and overseas. Authors are welcome to suggest possible referees to judge their work. Authors are responsible for the factual correctness of their contributions. *Bothalia* maintains an editorial board (see title page) to ensure that international standards are upheld.

PRESENTATION OF MANUSCRIPT

Manuscripts should be typewritten on one side of good quality A4-size paper, double-spaced throughout (including abstract, tables, captions to figures, literature references, etc.) and have a margin of at least 30 mm all round. The original and three photocopies (preferably **photocopied on both sides** of the paper to reduce weight for postage) of all items, including text, illustrations, tables and lists should be submitted, and the author should retain a complete set of copies. Papers should conform to the general style and layout of recent issues of *Bothalia* (from volume 14 onwards). Material should be presented in the following sequence: Title page with title, name(s) of author(s), keywords, abstracts (in English and Afrikaans) and information that should be placed in a footnote on the title page, such as address(es) of author(s) and mention of granting agencies. The sequence continues with Introduction and aims, Material and methods, Results, Interpretation (Discussion), Acknowledgements, Specimens examined (in revisions and monographs), References, Index of names (recommended for revisions dealing with more than about 15 species), Tables, Captions for figures and figures. In the case of short notes and book reviews, keywords and abstract are superfluous. All pages must be numbered consecutively beginning with the title page to those with references, tables and captions to figures.

AUTHOR(S)

When there are several authors the covering letter should indicate clearly which of them is responsible for correspondence and, if possible, telephonically available while the article is being processed. The contact address and telephone number should be mentioned if they differ from those given on the letterhead.

TITLE

The title should be as concise and as informative as possible. In articles dealing with taxonomy or closely related subjects the family of the taxon under discussion (see also *Names of taxa* under General below) should be mentioned in brackets but author citations should be omitted from plant names.

KEYWORDS

Up to 10 keywords (or index terms) should be provided in English in alphabetical sequence. The following points should be borne in mind when selecting keywords:

1, Keywords should be unambiguous, internationally acceptable words and not recently-coined little-known words; 2, they should be in a noun form and verbs should be avoided; 3, they should not consist of an adjective alone; adjectives should be combined with nouns; 4, they should not contain prepositions; 5, the singular form should be used for processes and properties, e.g. evaporation; 6, the plural form should be used for physical objects, e.g. augers; 7, location (province and/or country); taxa (species, genus, family) and vegetation type (community, veld type, biome) should be used as keywords; 8, keywords should be selected hierarchically where possible, e.g. both family and species should be included; 9, they should include terms used in the title; 10, they should answer the following questions: 10.1, what is the *active concept* in the document (activity, operation or process); 10.2, what is the *passive concept* or object of the active process (item on which the activity, operation or process takes place); 10.3, what is the means of accomplishment or how is the active concept achieved (technique, method, apparatus, operation or process); 10.4, what is the environment in which the active concept takes place (medium, location) and 10.5, what are the independent (controlled) and dependent variables? 11, questions 10.1 to 10.3 should preferably also be answered in the title.

ABSTRACT

Abstracts of no more than 200 words should be provided in English and Afrikaans. Abstracts are of great importance and should convey the essence of the article. They should refer to the geographical area concerned and, in taxonomic articles, mention the number of taxa treated. They should not contain information not appearing in the article. In articles dealing with taxonomy or closely related subjects all taxa from the rank of genus downwards should be accompanied by their author citations. Names of new taxa and new combinations should not be underlined. If the article deals with too many taxa only the important ones should be mentioned.

TABLE OF CONTENTS

A table of contents should be given for all articles longer than about six typed pages, unless they follow the strict format of a taxonomic revision.

ACKNOWLEDGEMENTS

Acknowledgements should be kept to the minimum compatible with the requirements of courtesy. Please give all the initials of the person(s) your are thanking.

LITERATURE REFERENCES

In text

Literature references in the text should be cited as follows: 'Jones & Smith (1986) stated . . .', or '. . . (Jones & Smith 1986)' when giving a reference simply as authority for a statement. When more than two authors are involved use the name of the first author followed by *et al.* When referring to more than one literature reference, they should be arranged alphabetically according to author and separated by a semicolon, e.g. (Anon. 1981, 1984; Davis 1976; Nixon 1940). Titles of books and names of journals should preferably not be mentioned in the text. If there is good reason for doing so, they should be treated as described in the paragraph *In reference list* below. Personal communications are given only in the text, not in the list of references. Please add the person's full initials to identify the person more positively.

In taxonomic articles

The correct name (not underlined) is to be followed by its author citation (underlined) and the full literature reference, with the name of the publication written out in full. Thereafter all literature references, including those of the synonyms, should only reflect author, page and year of publication, e.g. C. E. Hubb. in Kew Bulletin 15: 307 (1960); Boris *et al.*: 14 (1966); Boris: 89 (1967); Sims: t. 38 (1977); Sims: 67 (1980). Note that (1) references are arranged in chronological sequence; (2) where two or more references by the same author are listed in succession, the author's name is repeated with every reference; (3) names of authors are written in the same way (see *Names of authors of plant names* under General), irrespective of whether the person in question is cited as the author of a plant name or of a publication; (4) the word 'figure' is written as 'fig.', and 't.' is used for both 'plate' and 'tablet'.

Literature references providing good illustrations of the species in question may be cited in a paragraph commencing with the word Icones followed by a colon. This paragraph is given after the last paragraph of the synonymy.

In reference list

All publications referred to in the text, including those mentioned in full in the treatment of correct names in taxonomic papers, but no others, and no personal communications, are listed at the end of the manuscript under the heading References. The references are arranged alphabetically according to authors and chronologically under each author, with a, b, c, etc. added to the year, if the author has published more than one work in a year. If an author has published both on his own and as a senior author with others, the solo publications are listed first and after that, in strict alphabetical sequence, those published with one or more other authors. Author names are typed in capitals. Titles of journals and of books are written out in full and are underlined as follows: *Transactions of the Linnean Society of London* 5: 171–217, or *Biology and ecology of weeds*: 24. Titles of books should be given as in *Taxonomic literature*, edn 2 by Stafleu & Cowan and names of journals as in *World list of scientific periodicals*, edn 4. If the same author is mentioned more than once, the name is written out in full and not replaced by a line.

Examples of references:

Collective book or Flora

BROWN, N. E. 1909. Asclepiadaceae. In W. T. Thiselton-Dyer, *Flora capensis* 6,2: 518–1036. Reeve, London.

BROWN, N. E. 1915. Asclepiadaceae. In W. T. Thiselton-Dyer, *Flora of tropical Africa* 5,2: 500–600. Reeve, London.

Book

DU TOIT, A. L. 1966. *Geology of South Africa*, 3rd edn, S. M. Haughton (ed.). Oliver & Boyd, London.

HUTCHINSON, J. 1946. *A botanist in southern Africa*. Gawthorn, London.

Journal

DAVIS, G. 1988. Description of a proteoid-restioid stand in Mesic Mountain Fynbos of the south-western Cape and some aspects of its ecology. *Bothalia* 18: 279–287.

STEBBINS, G. L. Jr 1952. Aridity as a stimulus to plant evolution. *American Naturalist* 86: 35–44.

SMOOK, L. & GIBBS RUSSELL, G. E. 1985. Poaceae. *Memoirs of the Botanical Survey of South Africa* No. 51: 45–70.

In press, in preparation

TAYLOR, H. C. in press. *A reconnaissance of the vegetation of Rooiberg State Forest*. Department of Forestry, Technical Bulletin.

VOGEL, J. C. 1982. The age of the Kuiseb river silt terrace at Homeb. *Palaeoecology of Africa* 15. In press.

WEISSER, P. J., GARLAND, J. F. & DREWS, B. K. in prep. Dune advancement 1937–1977 and preliminary vegetation succession chronology at Mlalazi Nature Reserve, Natal, South Africa. *Bothalia*.

Thesis

KRUGER, F. J. 1974. *The physiography and plant communities of the Jakkalsrivier Catchment*. M. Sc. (Forestry) thesis, University of Stellenbosch.

Miscellaneous paper, report, unpublished article, technical note, congress proceedings

ANON. no date. *Eetbare plante van die Wolkberg*. Botanical Research Unit, Grahamstown. Unpublished.

BAWDEN, M. G. & CARROL, D. M. 1968. *The land resources of Lesotho*. Land Resources Study No. 3, Land Resources Division, Directorate of Overseas Surveys, Tolworth.

BOUCHER, C. 1981. Contributions of the Botanical Research Institute. In A. E. F. Heydorn, *Proceedings of workshop research in Cape estuaries:* 105–107. National Research Institute for Oceanology, CSIR, Stellenbosch.

NATIONAL BUILDING RESEARCH INSTITUTE 1959. *Report of the committee on the protection of building timbers in South Africa against termites, woodboring beetles and fungi*, 2nd edn, CSIR Research Report No. 169.

TABLES

Each table should be presented on a separate sheet and be assigned an Arabic numeral, i.e. the first table men-

tioned in the text is marked 'Table 1'. In the captions of tables the word 'table' is written in capital letters. See recent numbers of *Bothalia* for the format required. Avoid vertical lines, if at all possible. Tables can often be reduced in width by interchanging primary horizontal and vertical heads.

FIGURES

General

Figures should be planned to fit, after reduction, into a width of either 80, 118 or 165 mm, with a maximum vertical length of 240 mm. Allow space for the caption in the case of figures that will occupy a whole page. Lettering and numbering on all figures should be done in letraset, stencilling or a comparable method. If symbols are to be placed on a dark background it is recommended that black symbols are used on a small white disk. If the lettering or wording on a figure is to be done by the printer this information must be typed or neatly printed on a photocopy of the figure or on an overlay attached to the original. If several illustrations are treated as components of a single composite figure they should be designated by capital letters. Note that the word 'figure' should be written out in full, both in the text and the captions. In the text the figure reference is then written as in the following example: 'The stamens (Figure 4A, B, C) are . . .'. In captions, 'figure' is written in capital letters. Magnification of figures should be given for the size as submitted. It is recommended, however, that scale bars or lines be used on figures. In figures accompanying taxonomic papers, voucher specimens should be given in the relevant caption. Figures are numbered consecutively with Arabic numerals in the order they are referred to in the text. These numbers, as well as the author's name and an indication of the top of the figure, must be written in soft pencil on the back of all figures. Authors should indicate in pencil in the text where they would like the figures to appear. Authors wishing to have the originals of figures returned must inform the editor in the original covering letter and must mark each original 'To be returned to author'. Authors wishing to use illustrations already published must obtain written permission before submitting the manuscript and inform the editor of this fact. Captions for figures should be collected together and typed on a separate sheet headed *Captions for figures*.

Black and white drawings

Line drawings, including graphs and diagrams, should be in jet-black Indian ink, preferably on bristol board or tracing film. Lines should be bold enough to stand reduction. It is recommended that drawings should be twice the size of the final reproduction.

Photographs

Photographs should be of excellent quality on glossy paper with clear detail and moderate contrast, and they should be the same size as required in the journal. Photograph mosaics should be submitted complete, the component photographs mounted neatly on a white card base leaving a narrow gap of uniform width between each print. Note that grouping photograhps of markedly divergent contrast results in poor reproductions.

Dot maps

It is strongly recommended that taxonomic articles include dot maps as figures to show the distribution of taxa. The dots used must be large enough to stand reduction to 80 mm (recommended size: letraset 5 mm diameter). Blank maps are available from the editor.

Names of taxa

As a rule authors should use the names as listed by Gibbs Russell *et al.* in *Memoirs of the Botanical Survey of South Africa* Nos 48, 51 and 56. Names of genera and infrageneric taxa are usually underlined with the author citation (where relevant) not underlined. Exceptions include names of new taxa in the abstracts, correct names given in the synopsis or in paragraphs on species excluded from a given supraspecific group in taxonomic articles in checklists and in indices, where the position is reversed, correct names being not underlined and synonyms underlined. Names above generic level are not underlined. In articles dealing with taxonomy and closely related subjects the complete scientific name of a plant (with author citation) should be given at the first mention in the text. The generic name should be abbreviated to the initial thereafter, except where intervening references to other genera with the same initial could cause confusion.

Names of authors of plant names

These should agree with the list compiled by the BRI (TN TAX 2/1) which has also been implemented by Gibbs Russell *et al.* in *Memoirs of the Botanical Survey of South Africa* Nos 48, 51 and 56. Modern authors not included in the list should use their full name and initials when publishing new plant names. Other author names not in the list should be in agreement with the recommendations of the Code.

Names of authors of publications

These are written out in full except in the synonymy in taxonomic articles where they are treated like names of authors of plant names.

Names of plant collectors

These are underlined whenever they are linked to the number of a specimen. The collection number is also underlined, e.g. *Acocks 14407*. Surnames beginning with 'De', 'Du' or 'Van' begin with a capital letter unless preceded by an initial.

Measurements

Use only units of the International System of Units (SI). Cm should not be used, only mm and/or m. The use of '±' is preferred to c. or ca.

Numerals

Numbers 'one' to 'nine' are spelled out in normal text, and from 10 onwards they are written in Arabic numerals. In descriptions of plants, numerals are used throughout. Write 2,0–4,5 (not 2–4,5). When counting members write 2 or 3 (not 2–3).

Abbreviations

Abbreviations should be used sparingly but consistently. No full stops are placed after abbreviations ending with the last letter of the full word (e.g. edition = edn; editor =ed.), after units of measure, after compass directions and after herbarium designations.

KEYS TO TAXA

It is recommended that (apart from multi-access keys) indented keys be used with couplets numbered 1a–1b, 2a–2b, etc. (without full stops thereafter). Keys consisting of a single couplet have no numbering. Manuscripts of keys should be presented as in the example below.

Herbarium voucher specimens

Wherever possible authors should refer to one or more voucher specimen(s) in a registered herbarium.

SPECIES TREATMENT IN TAXONOMIC PAPERS

General presentation

The procedure to be followed is illustrated in the example (under Description and example of species treatment, below), which should be referred to, because not all steps are described in full detail. The correct name (see also *Names of taxa,* under General), with its literature citations is followed by the synonymy (if any), the description and the discussion, which should consist of paragraphs commencing, where possible, with italicised leader words such as *flowering time, diagnostic characters, distribution* and *habitat.*

Numbering

When more than one species of a given genus is dealt with in a paper, the correct name of each species should be prefixed by a sequential number followed by a full stop, the first line of the paragraph to be indented. Infraspecific taxa are marked with small letters, e.g. 1b., 12c., etc.

Literature references within synonymy

(See above under *Literature references,* paragraph 2.)

Citation of specimens

Type specimen in synopsis

The following should be given (if available): country (if not in RSA), province, locality as given by original collector, modern equivalent of collecting locality in square brackets (if relevant), date of collection (optional), collector's name and collecting number (both underlined). The abbreviation *s.n. (sine numero)* is given after the name of a collector who usually assigned numbers to his collections but did not do so in the specimen in question. The herbaria in which the relevant type(s) are housed are indicated by means of the abbreviations given in the latest edition of *Index Herbariorum.* The holotype (holo.) and its location are mentioned first, followed by a semicolon, the other herbaria are arranged alphabetically, separated by commas. Authors should indicate by means of an exclamation mark (!) which of the types have been personally examined. If only a photograph or microfiche was seen, write as follows: *Anon. 422* (X, holo.—BOL, photo.!). Lectotypes or neotypes should be chosen for correct names without a holotype. It is not necessary to lectotypify synonyms. When a lecto- or a neotype are newly chosen this should be indicated by using the phrase 'here designated'. If reference is made to a previously selected lectotype or neotype, the name of the designating author and the literature reference should be given. In cases where no type was cited, and none has subsequently been nominated, this may be stated as 'not designated'.

In notes and brief taxonomic articles

In brief papers mentioning only a few species and a few cited specimens the specimens should be arranged according to the grid reference system:

Provinces/countries (typed in capitals) should be cited in the following order: SWA/Namibia, Botswana, Transvaal, Orange Free State, Swaziland, Natal, Lesotho, Transkei and Cape. Grid references should be cited in numerical sequence. Locality records for specimens should preferably be given to within a quarter-degree square. Records from the same one-degree square are given in alphabetical order, i.e. (—AC) precedes (—AD), etc. Records from the same quarter-degree square are arranged alphabetically according to the collector's names; the quarter-degree references must be repeated for each specimen cited. The relevant international code of the herbaria in which a collection was seen should be given in brackets after the collection number; the codes are separated by commas. The following example will explain the procedure:

NATAL.—2731 (Louwsburg): 16 km E of Nongoma (—DD), *Pelser 354* (BM, K, PRE); near Dwarsrand, *Van der Merwe 4789* (BOL, M). 2829 (Harrismith): near Groothoek (—AB), *Smith 234*; Koffiefontein (—AB), *Taylor 720* (PRE); Cathedral Peak Forest Station (—CC), *Marriot 74* (KMG); Wilgerfontein, *Roux 426.* Grid ref. unknown: Sterkstroom, *Strydom 12* (NBG).

For records from outside southern Africa authors should use degree squares without names, e.g.:

KENYA.—0136: Nairobi plains beyond race course, *Napier 485.*

If long lists of specimens are given, they should be dealt with as on p. 149, paragraph 5.

1a Leaves closely arranged on an elongated stem; a submerged aquatic with only the capitula exserted .... 1b. *E. setaceum* var. *pumilum*
1b Leaves in basal rosettes; stems suppressed; small marsh plants, ruderals or rarely aquatics:
2a Annuals, small, fast growing pioneers, dying when the habitat dries up; capitula without coarse white setae; receptacles cylindrical:
3a Anthers white .... 2. *E. cinereum*
3b Anthers black .... 3. *E. nigrum*
2b Perennials, more robust plants; capitula sparsely to densely covered with short setae:

In monographs and revisions

In the case of all major works of this nature it is assumed that the author has investigated the relevant material in all major herbaria and that he has provided the specimens seen with determinavit labels. It is assumed further that the author has submitted distribution maps for all relevant taxa and that the distribution has been described briefly in words in the text. Under the heading 'Vouchers' no more than 5 specimens should be cited, indicating merely the collector and the collector's number (both underlined). Specimens are alphabetically arranged according to collector's name. If more than one specimen by the same collector is cited, they are arranged numerically and separated by a semicolon. The purpose of the cited specimens is not to indicate distribution but to convey the author's concept of the taxon in question.

The herbaria in which the specimens are housed are indicated by means of the abbreviation given in the latest edition of *Index Herbariorum*. They are given between brackets, arranged alphabetically and separated by commas behind every specimen as in the following example:

Vouchers: *Fisher 840* (NH, NU, PRE); *Flanagan 831* (GRA, PRE); *840* (NH, PRE); *Marloth 4926* (PRE, STE); *Schelpe 6161, 6163, 6405* (BOL); *Schlechter 4451* (BM, BOL, GRA, K, PRE).

All specimens studied by the author should be listed together at the end of the article under the heading *Specimens examined*. They are arranged alphabetically by the collector's name and then numerically for each collector. The species is indicated in brackets by the number that was assigned to it in the text and any infraspecific taxa by a small letter. If more than one genus is dealt with in a given article, the first species of the first genus mentioned is indicated as 1.1. This is followed by the international herbarium designation. Note that the name of the collector and the collection number are underlined:

Acocks 12497 (2.1b) BM, K, PRE; *14724* (1.13a) BOL, K, P. *Archer 1507* (1.4) BM, G.

Burchell 2847 (2.8c) MB, K. *Burman 2401* (3.3) MO, S. *Burtt 789* (2.6) B, KMG, STE.

Synonyms

In a monograph or a revision covering all of southern Africa, all synonyms based on types of southern African origin, or used in southern African literature, should be included. Illegitimate names are designated by *nom. illeg.* after the reference, followed by *non* with the author and date, if there is an earlier homonym. *Nomina nuda (nom. nud.)* and invalid names are excluded unless there is a special reason to cite them, for example if they have been used in prominent publications. Note that in normal text Latin words are italicized, but in the synopsis of a species Latin words such as *nom. nud.* are not italicized.

Synonyms should be arranged chronologically into groups of nomenclatural synonyms, i.e. synonyms based on the same type, and the groups should be arranged chronologically by basionyms, except for the basionym of the correct name which is dealt with in the paragraph directly after that of the correct name. When a generic name is repeated in a given synonymy it should be abbreviated to the initial except where intervening references to other genera with the same initial could cause confusion.

Description and example of species treatment

Descriptions of all taxa of higher plants should, where possible, follow the sequence: Habit; sexuality; underground parts (if relevant). *Indumentum* (if it can be easily described for the whole plant). *Stems/branches. Bark. Leaves*: arrangement, petiole absent/present, pubescence; blade: shape, size, apex, base, margin; midrib: above/below, texture, colour; petiole; stipules. *Inflorescence*: type, shape, position; bracts/bracteoles. *Flowers*: shape, sex. *Receptacle. Calyx. Corolla. Disc. Androecium. Gynoecium. Fruit. Seeds. Chromosome number*. Figure (word written out in full) number. As a rule shape should be given before measurements. In general, if an organ has more than one of the parts being described, use the plural, otherwise use the singular, for example, petals of a flower but blade of a leaf. Language must be as concise as possible, using participles instead of verbs. Dimension ranges should be cited as in the example below. Care must be exercised in the use of dashes and hyphens: a *hyphen* is a short stroke joining two syllables of a word, e.g. ovate-lanceolate or sea-green; an *N-dash (en)* is a longer stroke commonly used instead of the word 'to' between numerals, '2–5 mm long' (do not use it between words but rather use the word 'to', e.g. 'ovate to lanceolate'); it is produced on a typewriter by typing 2 hypens next to each other; and an *M-dash (em)* is a stroke longer than an N-dash and is used variously, e.g. in front of a subspecific epithet instead of the full species name; it is produced on a typewriter by typing 3 hypens next to one another. The use of '±' is preferred to c. or ca when describing shape, measurements, dimensions, etc.

Example:

1. **Bequaertiodendron magalismontanun** *(Sond.) Heine & Hemsl.* in Kew Bulletin: 307 (1960); Codd: 72 (1964); Elsdon: 75 (1980). Type: Transvaal, Magaliesberg, *Zeyher 1849* (S, holo.—BOL, photo.!).

Chrysophyllum magalismontanum Sond.: 721 (1850); Harv.: 812 (1867); Engl.: 434 (1904); Bottmar: 34 (1919). *Zeyherella magalismontanum* (Sond.) Aubrév. & Pelegr.: 105 (1958); Justin: (1973).

Chrysophyllum argyrophyllum Hiern: 721 (1850); Engl.: 43 (1904). *Boivinella argyrophylla* (Hiern) Aubrév. & Pellegr.: 37 (1958); Justin: 98 (1973). Types: Angola, *Welwitsch 4828* (BM!, lecto., here designated; PRE!); Angola, *Welwitsch 4872* (BM!).

Chrysophyllum wilmsii Engl.: 4, t. 16 (1904); Masonet: 77 (1923); Woodson: 244 (1937). *Boivinella wilmsii* (Engl.) Aubrév. & Pellegr.: 39 (1958); Justin: 99 (1973). Type: Transvaal, Magoebaskloof, *Wilms 1812* (B, holo.; K!, P!, lecto., designated by Aubrév. & Pellegr.: 38 (1958), PRE!, S! W!, Z!).

Bequaertiodendron fruticosa De Wild.: 37 (1923), non Bonpland: 590 (1823); Bakker: 167 (1929); Fries: 302 (1938); Davy: 640 (1954); Breytenbach: 117 (1959); Clausen: 720 (1968); Palmer: 34 (1969). Type: Transvaal, Tzaneen Distr., *Granville 3665* (K, holo.!; G!, P!, PRE!, S!).

Bequaertiodendron fragrans auct. non Oldemann: Glover: 149, t. 19 (1915); Henkel: 226 (1934); Stapelton: 6 (1954).

Icones: Harv.: 812 (1867); Henkel: t. 84 (1934); Codd: 73 (1964); Palmer: 35 (1969).

Woody perennial; main branches up to 0,4 m long, erect or decumbent, grey woolly-felted, leafy. *Leaves* 3–10 (–23) × 1,0–1,5(–4,0) mm, linear to oblanceolate, obtuse, base broad, half-clasping. *Heads* heterogamous, campanulate, 7–8 × 5 mm, solitary, sessile at tip of axillary shoots; involucral bracts in 5 or 6 series, inner

exceeding flowers, tips subopaque, white, very acute. *Receptacle* nearly smooth. *Flowers* ± 23–30, 7–11 male, 16–21 bisexual, yellow, tipped pink. *Achenes* ± 0,75 mm long, elliptic. *Pappus* bristles very many, equalling corolla, scabridulous. *Chromosome number*: 2n = 22. Figure 23 B.

New taxa

The name of a new taxon must be accompanied by at least a Latin diagnosis. Authors should not provide full-length Latin descriptions unless they have the required expertise in Latin at their disposal. It is recommended that descriptions of new taxa be accompanied by a good illustration (line drawing or photograph) and a distribution map.

Example:

109. **Helichrysum jubilatum** *Hilliard,* sp. nov. *H. alsinoidei* DC. affinis, sed foliis ellipticis (nec spatulatis), inflorescentiis compositis a foliis non circumcinctis, floribus femineis numero quasi dimidium hermaphroditorum aequantibus (nec capitulis homogamis vel floribus femineis 1–3 tantum) distinguitur.

Herba annua e basi ramosa; caules erecti vel decumbentes, 100–250 mm longi, tenuiter albo-lanati, remote foliati. *Folia* plerumque 8–30 × 5–15 mm, sub capitulis minora, elliptica vel oblanceolata, obtusa vel acuta, mucronata, basi semi-amplexicauli, utrinque cano-lanato-arachnoidea. *Capitula* heterogama, campanulata, 3,5–4,0 × 2,5 mm, pro parte maxima in paniculas cymosas terminales aggregata; capitula subterminalia interdum solitaria vel 2–3 ad apices ramulorum nudorum ad 30 mm longorum. *Bracteae involucrales* 5-seriatae, gradatae, exteriores pellucidae, pallide stramineae, dorso lanatae, seriebus duabus interioribus subaequalibus et flores quasi aequantibus, apicibus obtusis opacis niveis vix radiantibus. *Receptaculum* fere laeve. *Flores* ± 35–41. *Achenia* 0,75 mm longa, pilis myxogenis praedita. *Pappi* setae multae, corollam aequantes, apicibus scabridis, basibus non cohaerentibus.

TYPE.—Cape, Namaqualand Division, Richtersveld, ± 5 miles E of Lekkersing on road to Stinkfontein, kloof in hill south of the road, annual, disc whitish, 7 xi 1962, *Nordenstam 1823* (S, holo.; E, NH, PRE).

PROOFS

Only galley proofs are normally sent to authors. They should be corrected in red ink and be returned to the editor as soon as possible.

REPRINTS

Authors receive 100 reprints free. If there is more than one author, this number will have to be shared between them.

DOCUMENTS CONSULTED

Guides to authors of the following publications were made use of in the compilation of the present guide: *Annals of the Missouri Botanic Garden, Botanical Journal of the Linnean Society, Bothalia, Flora of Australia, Smithsonian Contributions to Botany, South African Journal of Botany* (including instructions to authors of taxonomic papers), *South African Journal of Science*.

ADDRESS OF EDITOR

Manuscripts should be submitted to: The Editor, Bothalia, Botanical Research Institute, Private Bag X101, Pretoria 0001.

Bothalia 19,2: 151–156 (1989)

Studies in the southern African species of *Justicia* and *Siphonoglossa* (Acanthaceae): palynology

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Keywords: Acanthaceae, *Justicia*, palynology, *Siphonoglossa*, southern Africa, taxonomy

ABSTRACT

The gross morphology of the pollen of all southern African species and subspecies of *Justicia* and *Siphonoglossa* was investigated, as well as that of eight tropical African species of *Justicia*. The following pollen types were found in the southern African species of *Justicia*: two- or three-colporate, each with the margocolpus either entire or broken up into areolae, and two-porate areolate pollen. One tropical African species had the colpus very short, and in another tropical African species it was replaced by an extra row of areolae. All *Siphonoglossa* species had two-colporate pollen with areolae and long colpi. The southern African species of *Justicia* could be separated from *Siphonoglossa* on pollen characters, and some sections of *Justicia* could also be distinguished on the same basis.

UITTREKSEL

Die algemene morfologie van die stuifmeel van alle spesies en subspesies van *Justicia* en *Siphonoglossa* in Suider-Afrika, asook dié van agt *Justicia*-spesies uit tropiese Afrika, is ondersoek. Die volgende stuifmeeltipes is by die *Justicia*-spesies van Suider-Afrika gevind: twee- of driekolporaat, elk met die margokolpus òf gaaf òf opgebreek in areole, en tweeporate areolêre stuifmeel. By een spesie uit tropiese Afrika was die kolpus baie kort, en by 'n ander uit tropiese Afrika is dit deur 'n ekstra ry areole vervang. Alle *Siphonoglossa*-spesies het tweekolporate stuifmeel met areole en lang kolpusse gehad. Die *Justicia*-spesies van Suider-Afrika kon op grond van stuifmeelkenmerke van *Siphonoglossa* geskei word, en sommige *Justicia*-seksies kon ook op dieselfde basis onderskei word.

INTRODUCTION

The gross morphology of the pollen of all southern African species and subspecies of *Justicia* and *Siphonoglossa* was investigated, as well as that of eight tropical African species of *Justicia*. In order to place the studies into perspective, brief reference is made to findings of other researchers.

Radlkofer (1883) was the first to point out the potential value of the pollen in classification of the Acanthaceae, but it was Lindau (1895) who first attempted to use the pollen systematically in its classification.

The 'typical representatives' of the subtribe Justiciinae, according to Bremekamp (1965), have prolate, dorsiventrally flattened pollen, with the pore in the middle of a trema area which is studded with circular 'insulae' (areolae).

Stearn (1971), after discussing the pollen type of a number of Jamaican species of *Justicia*, concluded that 'The palynology of the group as a whole must certainly have a significant part in its reclassification. Pending that reclassification, *Justicia* is probably best accepted in a broad sense'.

Gibson (1972) widened the circumscription of *Justicia* and, if her delimitation is accepted, the range of pollen types present in the genus will be greatly increased, and will include 3- and 4-porate pollen and pollen with the areolae scattered across the face of the grain.

Balkwill & Getliffe Norris (1988), who reappraised the tribal and subtribal limits of Acanthaceae in southern Africa, considered that in southern Africa each tribe had a characteristic pattern of pollen 'against which aberrant genera can be contrasted'. They considered prolate tricolporate grains with entire margocolpi as being the primitive state.

Graham (1989) surveyed a number of species of *Justicia* and related genera worldwide, and greatly widened the circumscription of the genus to include a number of formerly segregate genera, including *Siphonoglossa*. She divided the genus into a number of sections and subsections which have been followed here, and considered pollen, in combination with other characters, to be of major taxonomic importance. She considered the South African species of *Siphonoglossa* to belong in *Justicia*, but not in the same section as the South American species of *Justicia*. She described 10 pollen types, but did not confirm the 4-aperturate pollen types reported for a few New World species.

METHODS AND MATERIALS

In this study the pollen of all southern African species and subspecies of *Justicia* and *Siphonoglossa* was investigated with the SEM. Taxa covered were all those occurring in southern Africa as defined by the *Flora of southern Africa*. Eight tropical African species were also investigated for purposes of comparison, but were not measured.

Material was obtained from three sources: herbarium sheets, fresh material grown in the greenhouse at the Botanical Research Institute, Pretoria, and material preserved in alcohol (gathered in the field).

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MS. received: 1988.07.16.

Fresh material of two of the species, *J. flava* (Vahl) Vahl and *J. protracta* (Nees) T. Anders. subsp. *protracta*, was also acetolysed (following Erdtman 1971, as quoted by Taylor, Hollingsworth & Bigelow 1974), before being mounted and viewed. The acetolysed material was then compared with that of the same species mounted directly onto stubs.

One to four specimens of each species and subspecies of *Justicia* and *Siphonoglossa* in southern Africa were examined. The anthers were macerated onto 15 mm aluminium stubs covered with double-sided adhesive tape. Thin tape was used, as the pollen grains tended to sink partially into the thicker gum of some tapes and became difficult to photograph well.

After air-drying, the mounted material was glow-discharge-coated with ± 400 A° of metallic gold in an Eiko sputter coater. The specimens were then viewed with an MSM 4 Hitachi-Akashi (desk top model) SEM at kv 15. Selected views were photographed of the profile (face), side and amb (polar) faces of the pollen grains of each taxon, using a Mamiya 6 × 7 camera and Ilford FP4 125 ASA film. The film was developed in Microdol X.

The size of the pollen grains was measured from water-mounted pollen with a Kontron Image analyser.

The terminology used is illustrated in Figure 1.

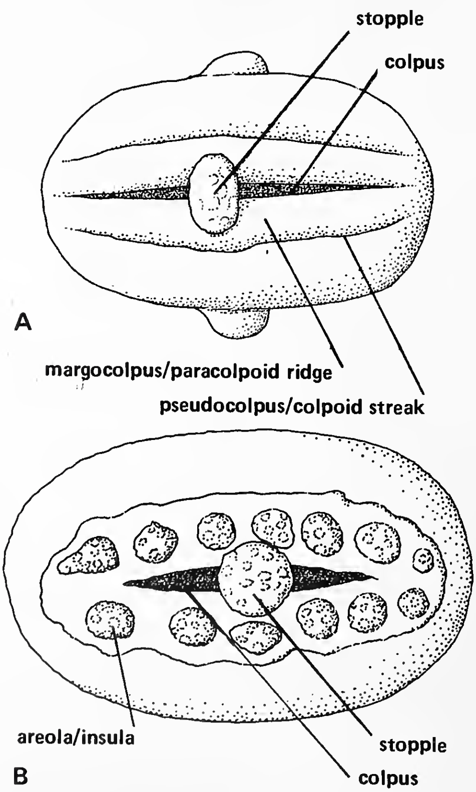

FIGURE 1.—Diagrams of pollen grains in *Justicia* and *Siphonoglossa*: A, with entire margocolpus, × 2400; B, with areolae, × 2400.

RESULTS AND DISCUSSION

No differences were observed between pollen taken from fresh and from dried material when it was viewed.

No significant difference was found between acetolysed material and material mounted directly onto the stubs. This is similar to the findings of Munday (1980) in *Monechma*, except that acetolysed material tended to loose its 'stopples' and had a high proportion of damaged grains. Material was therefore viewed throughout without pretreatment, and results given are of such pollen.

Shape of pollen grains

The pollen of both *Justicia* and *Siphonoglossa* was found to be basically prolate, with some species, e.g. *J. orchioides* L. f., *J. platysepala* (S. Moore) P.G. Mey. and *J. thymifolia* (Nees) T. Anders., showing a slight median constriction (Figure 5C).

Sexine pattern

The sexine pattern was lophate or reticulate over most of the grain with smooth areas (margocolpi) on either side of the colpi.

These margocolpi were ornamented either with an entire band of lophate sexine (paracolpoid ridge) (Figure 1A) or this band was broken up into areolae, i.e. circular areas of lophate sexine (Figure 1B). The areolae were in one or two rows (*Justicia*) (Figure 3A; 4D, G; 5A) or sometimes in up to three rows (*Siphonoglossa*). The outer row was frequently partially merged with the main area of lophate sexine. In one tropical African species, *J. goetzei* Lindau, the area normally occupied by the colpus was occupied instead by a single row of areolae, as well as the row on either side, i.e. a total of three rows of areolae in the pair of margocolpi.

In the case of pollen with entire paracolpoid ridges, the colpoid streak (which appears as a furrow between the paracolpoid ridge and the main area of lophate sexine) would sometimes continue to the poles. This, however, may be variable (see also Balkwill & Getliffe Norris 1985), and has not been used in the classification. The pseudocolpi may actually join at the poles, for instance in *J. campylostemon* and *J. glabra* among the three-colporate species (Figure 2D).

Pores and colpi

The pollen grains have either two (Figures 4 & 5) or three pores (Figures 2 & 3). Each may lie within an elongate colpus running to near each pole. It is sometimes difficult to establish with certainty whether there is a colpus or not. Two species, however, *J. anselliana* (Nees) T. Anders. and *J. anagalloides* (Nees) T. Anders., were definitely without colpi (Figure 4G). An intermediate stage was seen in one of the tropical species, *J. elegantula* S. Moore, where the colpi were present but short. Another tropical African species, *J. goetzei*, had a single row of areolae where the colpus would normally be. In all species a granular stopple was present projecting from each pore (Figure 4B, C).

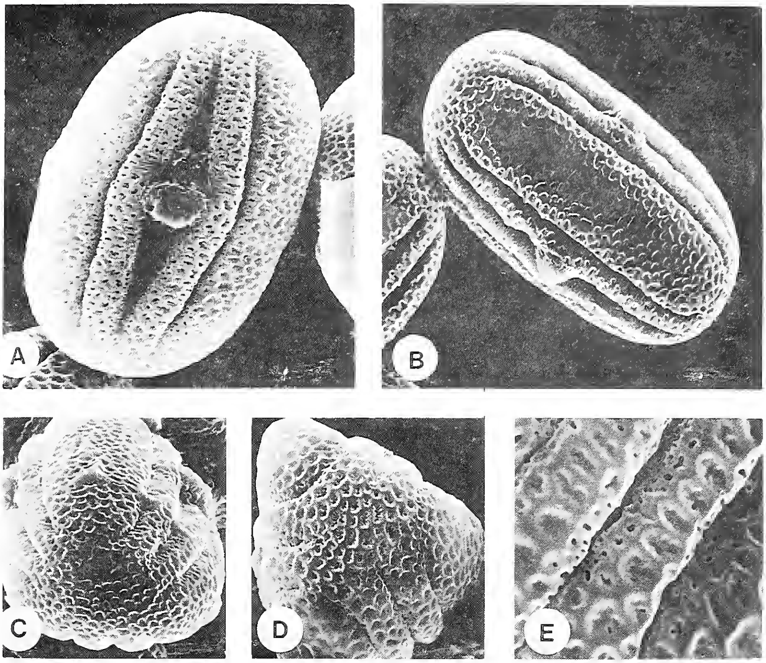

FIGURE 2.—Pollen of *Justicia* species, 3-colporate, margocolpi entire. A–C, *J. betonica*, *Strey 8161*: A, face; B, side; C, amb, all × 1200. D–E, *J. glabra*, *Smith 2734*: D, amb showing pseudocolpi continuous at poles, × 1200; E, surface detail, × 2900.

Length

The length of the pollen grains (taken between the poles) covered a wide range in the two genera. In *Justicia* it varied from 22 μm (*J. anselliana*) to 77 μm [*J. petiolaris* (Nees) T. Anders.] and in *Siphonoglossa* from 58 μm [*S. leptantha* (Nees) Immelman] to 90 μm [*S. linifolia* (Lindau) C.B. Cl.]. The pollen in the genera therefore varies from small to medium to large according to the categories of Erdtman (1952).

Size (length) of pollen grain, although used in the key below, has not been used to reach taxonomic decisions, as there is a large range in pollen sizes in each species, even in measurements taken from a single flower. Keys using pollen sizes would need to be drawn up with caution, and be based on a number of pollen samples from different individuals and populations.

Abnormal grains

These are seen occasionally in both genera, and take the form of a much larger than average, triangular grains with a trilete colpus (Figure 5F). It is presumed that these are what Bhaduri (1944) called 'giant grains'.

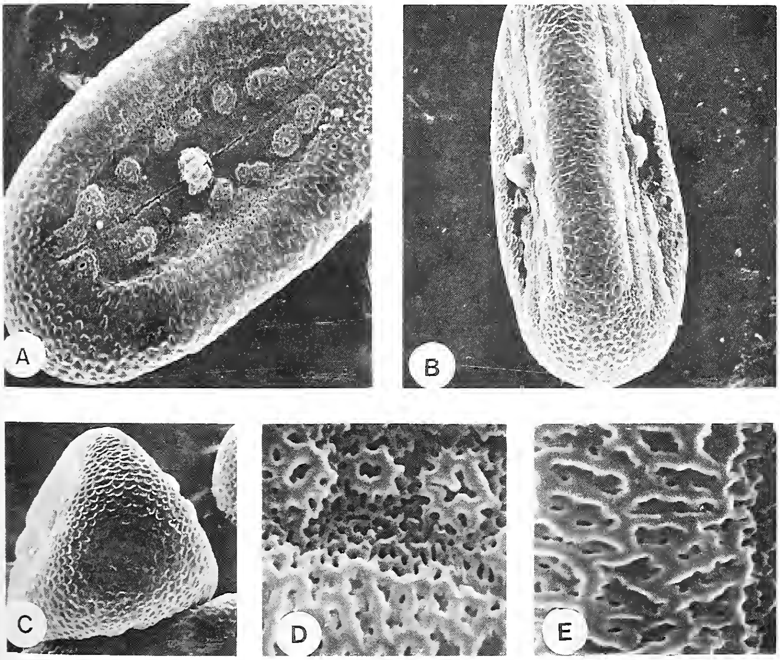

FIGURE 3.—Pollen of *Justicia* species, 3-colporate, margocolpi areolate. A & C, *J. kirkiana*, *Muir 1090*: A, face, × 1400; C, amb, × 10. B, *J. petiolaris* subsp. *incerta*, *Meeuse 9100*, side, × 1000. D & E, *J. flava*, *Werdermann & Oberdieck 1744*, surface detail showing areolae, × 4000.

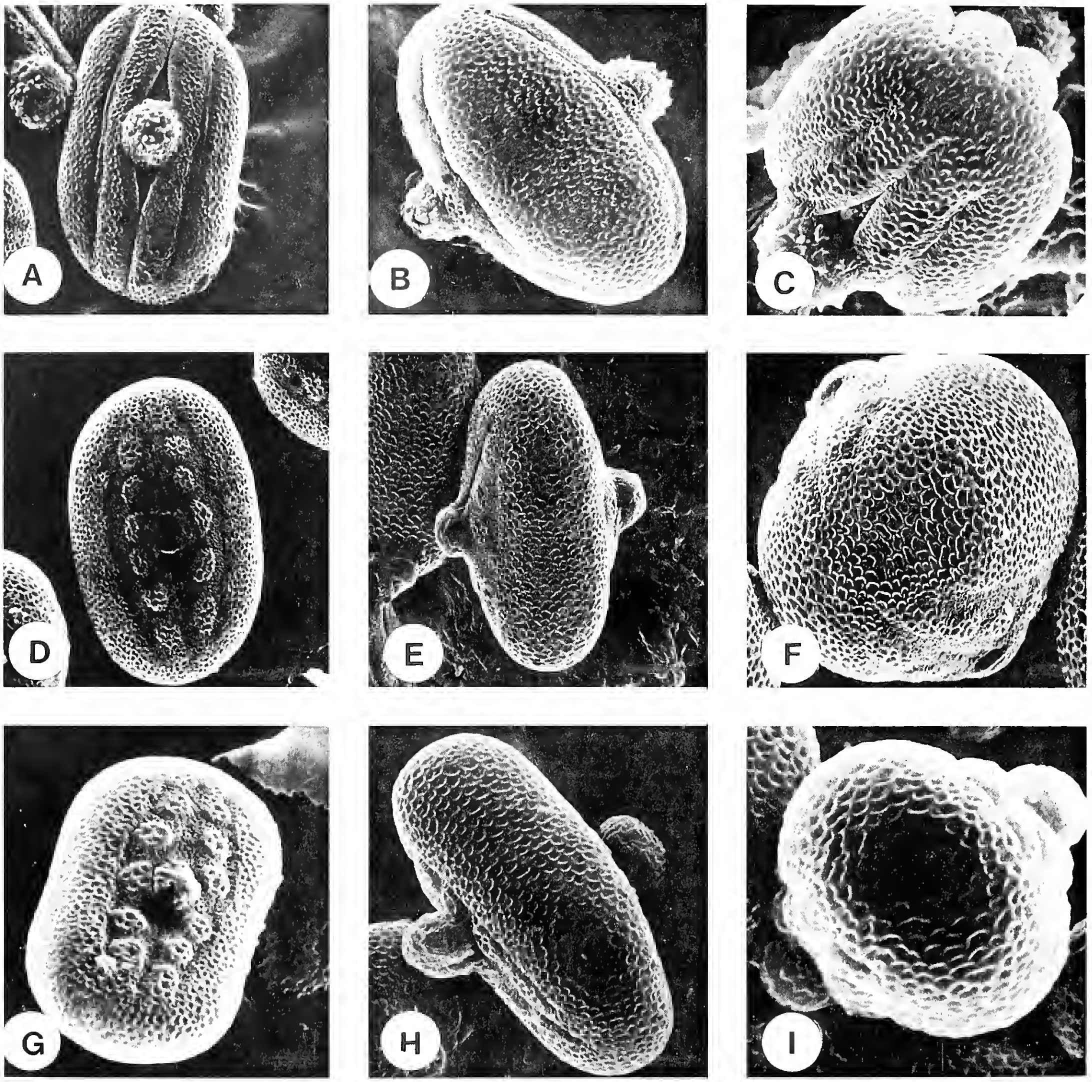

FIGURE 4.—Pollen of *Justicia* species, 2-colporate. Margocolpi entire: A–C, *J. guerkeana, Barnard 122*: A, face, × 1200; B, side, × 1200; C, amb, × 1600. Margocolpi areolate, D–I. D–F, *J. capensis, Acocks 20100*: D, face, × 900; E, side, × 900; F, amb, × 1400. G–H, *J. anagalloides, Hafstrom & Acocks 1390*: G, face, × 1800; H, side, × 1800. I, *J. anselliana, De Winter 2518*, face, × 3000.

Description of pollen of species seen (number in brackets is the mean length, n = 20):

Justicia

anagalloides (Nees) T. Anders.: two-porate, areolate, one row areolae, length 28 (31,1) 36 µm (*Hafstrom & Acocks 1390*) (Figure 4G, H).

anselliana (Nees) T. Anders.: two-porate, areolate, one row areolae, length 22 (31,3) 29 µm (*De Winter 2518*) (Figure 4I).

betonica L.: three-colporate, margocolpus entire, length 36 (46) 58 µm (*Strey 8161*) (Figure 2A, B, C).

bolusii C.B. Cl.: three-colporate, margocolpus entire, length 34 (46) 58 µm (*Immelman 376*).

campylostemon (Nees) T. Anders.: three-colporate, margocolpus entire, length 45 (49,8) 53 µm (*McClean 126*).

capensis Thunb.: two-colporate, areolate, one row areolae, length 48 (51,2) 60 µm (*Acocks 20100*) (Figure 4D, E, F).

caerulea Forssk.: two-colporate, areolate, one row areolae, length not measured (*Polhill & Paulo 1022*).

cordata (Nees) T. Anders.: two-colporate, margocolpus entire, length not measured (*Greenway & Kanuri 11357*).

crassiradix Burkill & C.B. Cl.: two-porate, areolate, one row areolae, length unknown (*Killick & Leistner 3417*).

cuneata Vahl (all three subspp.): two-colporate, margocolpus entire, length (subspp. *cuneata* & *longebracteata* only) 45 (50,9) 61 µm (subsp. *cuneata*: *Esterhuysen 5550*; subsp. *longebracteata*: *Dahlstrand 3157*; subsp. *hoerleiniana*: *Dinter H. 60401*).

dinteri S. Moore: two-colporate, areolate, 1–2 rows areolae, length 32 (37,2) 43 µm (*Edwards 4338, Smith 1339*).

elegantula S. Moore: shortly two-colporate, areolate, one row areolae, length not measured (*Salubeni 778*).

extensa T. Anders.: three-colporate, margocolpus entire, length not measured (*Leeuwenberg 6841*).

flava (Vahl) Vahl: three-colporate, areolate, one row areolae, length 42 (52,3) 58 µm (*Werdermann & Oberdieck 1744*) (Figure 3D, E).

glabra Koenig ex Roxb.: three-colporate, margocolpus entire, length 41 (43,4) 50 µm (*Smith 1700, 2734*). (Figure 2D, E).

goetzei Lindau: two-porate, areolate, one row areolae on either side of pore and a single row where colpus would usually be, length not measured (*Semsei 1657*).

guerkeana Schinz: two-colporate, margocolpus entire, length 35 (39,3) 45 µm (*Barnard 122*) (Figure 4A, B, C).

interrupta C.B. Cl.: three-colporate, margocolpus entire, length not measured (*R.B. & A.J. Faden 74/337*).

kirkiana T. Anders.: three-colporate, areolate, one row areolae, length 47 (54,2) 61 μm (*Muir 1090, Drummond 5329*) (Figure 3A, C).

minima A. Meeuse: three-colporate, areolate, two rows areolae, length 30 (33,3) 39 μm (*Immelman 145*).

montis-salinarum A. Meeuse: three-colporate, margocolpus entire, length 37 (41,8) 45 μm (*Van Wyk 5536*).

odora (Forssk.) Vahl: two-colporate, areolate, one row areolae, length 37 (41,8) 45 μm (*H. & E. Wanntorp 414*).

orchioides L. f. (both subspp.) two-colporate, margocolpus entire, length 30 (39,6) 49 μm (subsp. *orchioides*: *Hafstrom & Acocks H 905*; subsp. *glabrata* Immelman: *Muir 1100*).

petiolaris (Nees) T. Anders. (all three subspp.): three-colporate, areolate, one row areolae, length 56 (67) 77 μm (subsp. *petiolaris*: *McMurtry 1532*; subsp. *incerta* (C.B. Cl.) Immelman: *Meeuse 9100*; subsp. *bowiei* (C.B. Cl.) Immelman: *Marriott 3*) (Figure 3B).

parvibracteata Immelman: two-colporate, areolate, 1–2 rows areolae, length 35 (37,9) 42 μm (*Leistner 1402, 1657*).

platysepala (S. Moore) P.G. Mey.: two-colporate, margocolpus entire, length 32 (37,4) 44 μm (*Giess, Volk & Bleissner 5863*) (Figure 5C).

protracta (Nees) T. Anders. (both subspp.): two-colporate, areolate, 1–2 rows areolae, length 30 (41,9) 48 μm (subsp. *protracta*: *Hall 4563*; subsp. *rhodesiana*: *Germishuizen 974*).

stachytarphetoides C.B. Cl.: three-colporate, margocolpus entire, length not measured (*Tinley 2624*).

thymifolia (Nees) C.B. Cl.: two-colporate, margocolpus entire, length 53 (60,6) 68 μm (*Oliver, Tölken & Venter 61*).

Siphonoglossa

leptantha (Nees) Immelman (both subspp.): two-colporate, areolate, 2–3 rows areolae, length 58 (64,4) 77 μm (subsp. *leptantha*: *Galpin 7752, 10856*; subsp. *late-ovata* (C.B. Cl.) Immelman: *Fourcade 3724*) (Figure 5A, B, D, E, F).

linifolia (Lindau) C.B. Cl.: two-colporate, areolate, 2–3 rows areolae, length 74 (83,4) 90 μm (*Meeuse 10093*).

nkandlaensis Immelman: two-colporate, areolate, three rows areolae, length 71 (79,4) 88 μm (*Wells 2495*).

Key to pollen of *Justicia* and *Siphonoglossa* in southern Africa

Pollen longer than 58 μm, with 2–3 rows areolae ... *Siphonoglossa*
Pollen usually shorter than 58 μm or, if longer, then with one row of areolae or margocolpus entire .... *Justicia*

Key to pollen of sections of *Justicia* in southern Africa (Sectional delimitation follows Graham 1989)

1a Pollen 2-porate or 2-colporate:
 2a Pollen with entire margocolpus .... sect. *Justicia* p.p. (*J. orchioides, J. cuneata, J. thymifolia, J. guerkeana, J. platysepala*)
 2b Pollen with areolate margocolpus:
  3a Pollen usually 2-porate (in southern African species), 22–36 μm long .. sect. *Rostellularia* subsect. *Ansellia* p.p. (*J. anselliana, J. anagalloides, J. crassiradix*)
  3b Pollen 2-colporate, 34–60 μm long .... sect. *Harnieria* (*J. protracta, J. dinteri, J. parvibracteata, J. capensis, J. odora*)
1b Pollen 3-colporate:
 4a Pollen with entire margocolpus .... sect. *Raphidospora* (*J. glabra, J. campylostemon*)
 .... sect. *Justicia* p.p. (*J. bolusii*)
 .... sect. *Betonica* (*J. betonica, J. montis-salinarum*)
 4b Pollen with areolate margocolpus:
  5a Pollen shorter than 40 μm .... sect. *Rostellularia* subsect. *Ansellia* p.p. (*J. minima*)
  5b Pollen longer than 40 μm .... sect. *Tyloglossa* (*J. flava, J. kirkiana, J. petiolaris*)

CONCLUSION

A number of different pollen types were found in the southern African species of *Justicia*. Either two or three colpi were found, and the margocolpus was either entire or broken up into circular areolae. Most species examined had an elongated colpus, except for two southern African species of *Justicia* where the colpus was lacking, one tropical African species where it was short, and another tropical African species where it was replaced by an extra row of areolae. It was possible to divide the southern African species of *Justicia* from *Siphonoglossa* on pollen characters, and also to partially divide the southern African species of *Justicia* into sections on the same basis.

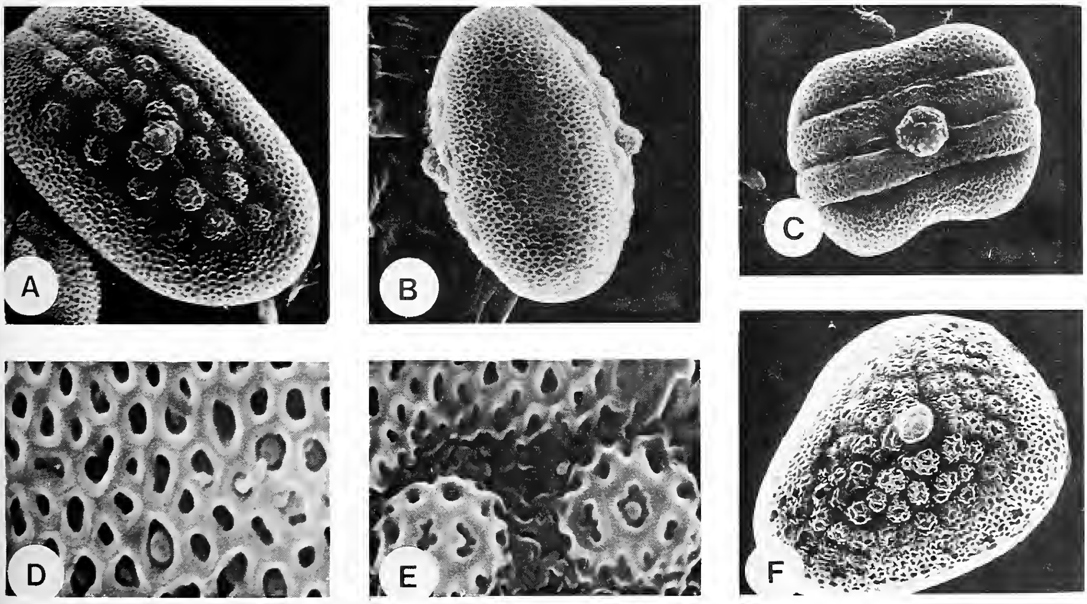

FIGURE 5.—Pollen of *Justicia* and *Siphonoglossa* species, 2-colporate, margocolpi areolate. A, B, D–F, *Siphonoglossa leptantha* subsp. *leptantha*, *Galpin 77512*: A, face, × 900; B, side, × 900; D, surface detail, × 5200; E, surface detail showing areolae, × 5200; F, abnormal trilete grain, × 900. C, *J. platysepala, Giess, Volk & Bleissner 5863*, face, × 1000.

The South African species of *Siphonoglossa* had two-colporate pollen with areolae and long colpi. On the basis of the pollen characters the genus would seem to most resemble *Justicia* sect. *Harnieria*.

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Studies in the genus *Riccia* (Marchantiales) from southern Africa. 13. A new species, *R. hantamensis*, in section *Pilifer* and a new record for *R. alatospora*

S.M. PEROLD*

Keywords: Marchantiales, *Riccia*, section *Pilifer*, southern Africa, taxonomy

ABSTRACT

Riccia hantamensis, a new species from the Hantams Mountain, District Calvinia, is described. It is clearly related to *R. alatospora*, but is a much larger plant. Like other species with a dorsal epithelium of free-standing cell pillars, it belongs to section *Pilifer* Volk. *R. alatospora*, originally only known from Platklip, Stellenbosch (Volk & Perold 1985), is now also recorded from Carolusberg, Hester Malan Reserve, Namaqualand.

UITTREKSEL

Riccia hantamensis, 'n nuwe spesie van die Hantamsberg, distrik Calvinia, word beskryf. Dit is duidelik verwant aan *R. alatospora*, maar is 'n veel groter plant. Soos die ander spesies met 'n dorsale epiteel van vrystaande selpilare, behoort *R. hantamensis* ook tot seksie *Pilifer* Volk. *R. alatospora*, oorspronklik slegs bekend van Platklip, Stellenbosch (Volk & Perold 1985), word nou ook vermeld van Carolusberg, Hester Malan Reservaat, Namakwaland.

R. hantamensis is known from only three collections from the Hantams Mountain, all in the same vicinity (Figure 1), but this whole area is undercollected as far as liverworts are concerned, so it may be more widely distributed. The specimen, *Germishuizen 4034*, consists of only male plants and has been cultivated for 26 months, growing luxuriantly in a seed tray on soil overlying peat. Subsequently female plants with ripe sporangia were collected at ± the same locality on two separate occasions. The species grows on ± neutral to somewhat alkaline soil, together with small *Crassula* spp. and mosses, e.g. *Didymodon ceratodonteus* (C. Müll.) Dix. in an area with predominantly fynbos vegetation. Altitude is ± 1 500 m above sea level, the annual rainfall is a winter one of less than 200 mm. The specific epithet refers to the only known locality.

Riccia hantamensis *Perold*, sp. nov.

Thallus dioicus, annuus, grandis, in vivo laete viridis aspectu nitido crystallino, in sicco flavo-virens. Frons usque ad 10 mm longa, 2,5–3,8 mm lata, 0,7–1,2 mm crassa, 3–3,5 plo latior quam crassa, symmetrice furcata vel bifurcata, oblonga vel obovata. Anatomia: epithelium dorsale e cellulis 3(–4) in columnis liberis, decrescentibus; tela assimilans canalibus aëriis 4–6–8 lateralibus ad 100 μm latis. Squamae parvae, hyalinae, apicem versus ventraliter positae. Sporae 60–85 μm diametro, ligno-brunneae, deltoideo-globulares, polares, ala usque ad 10 μm lata; superficie distale areolis 4 grandis centralibus, 15–20 μm latis, bulla centrali; superficie proximale signo triradiato distincto, areolis 5–10 μm latis, parietibus ad nodos prominentibus. *Chromosomatum numerus* n = 9 (Bornefeld pers. comm.).

TYPE.—Cape Province, 3119 (Calvinia): Hantams Mountain, Van Rhynshoek Farm, 8 km to FM tower, on clayey soil at streamlet next to road (–BD), 1987.10.03, *S.M. Perold 1830* (PRE, holo.).

Thallus dioicous, annual, bright green, with shiny, crystalline appearance, in crowded gregarious patches or scattered, medium-sized to rather large; branches once or twice symmetrically furcate (Figures 2A; 3A, B), closely to medium divergent, up to 10 mm long, terminal segments mostly short, 1,5–3,0 mm long, 2,5–3,8 mm wide, 0,7–1,2 mm thick, i.e. 3 to $3^{1/2}$ times wider than thick in section, shape oblong to obovate, generally widening distally; apex rounded to truncate (Figure 3C), shortly emarginate; groove apically deep, disappearing ± midway along length of thallus; margins rounded, obtuse, overhanging, flanks very obliquely sloping (Figure 2G), ventral surface gently rounded to flat, green (Figure 2G); when dry, yellowish green, margins raised and incurved, dorsally flat to slightly concave (Figure 2B). *Anatomy*: dorsal

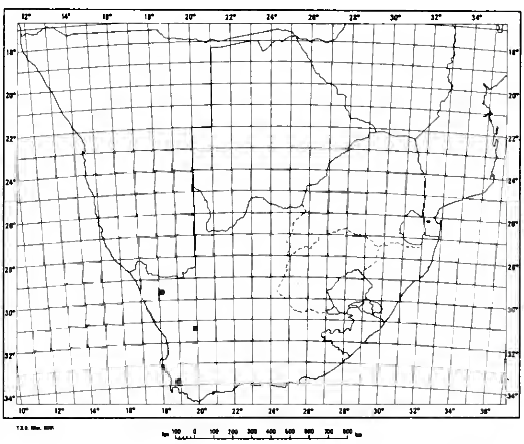

FIGURE 1.—Map showing distribution of *R. hantamensis* and *R. alatospora*.

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MS. received: 1989.01.25.

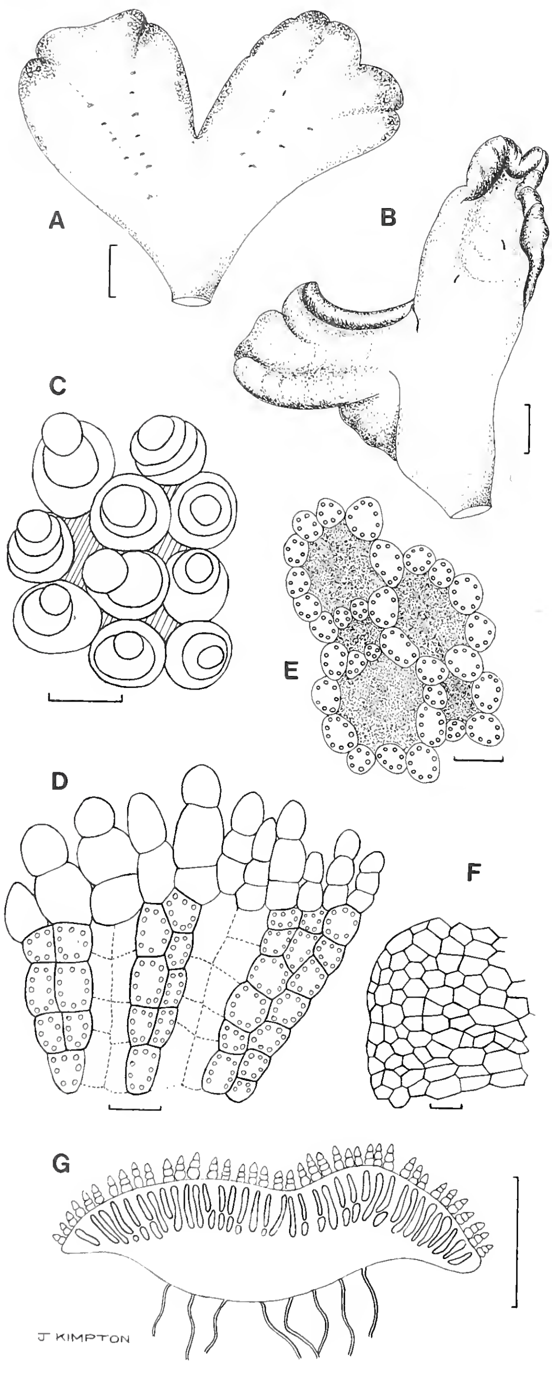

FIGURE 2.—*Riccia hantamensis*. Morphology and anatomy. A, male thallus with rows of antheridial necks, turgid; B, dry female thallus with 2 archegonial necks; C, dorsal cells and air pores (hatched lines) from above; D, transverse section through dorsal epithelium and assimilation tissue, showing wide air canals (cells with broken outlines); E, horizontal section through assimilation tissue, with air canals stippled; F, scale; G, transverse section through thallus branch. A, C, D, E, G, *Germishuizen 4034*; B, F, *S.M. Perold 1830*. Drawings by J. Kimpton. Scale bars on A, B, G = 1 mm; C–E = 50 μm; F = 100 μm.

epithelium ± 135–160 μm high, in free tapering pillars, consisting of 3(–4) thin-walled hyaline cells, 40–58 × 48–80 μm, topmost cells small, rounded to conical, basal cells wide and bulging at sides (Figures 2C, D; 3E, F), air pores 3–5-sided, proximally wider and clearly visible from above; assimilation tissue ± 350 μm thick in section, i.e. almost ½ the thickness of thallus, consisting of cells ± 50 × 35 μm, arranged in vertical columns up to 8 cells high and 1(–2) cells wide, with abundant chloroplasts, enclosing 4–6–8-sided, obliquely sloping air canals, up to 100 μm wide (Figure 2D, E); storage tissue ± 180–200 μm thick, ± ¼ the thickness of thallus, cells roundish, 62–70 × 55–85 μm. Rhizoids arising from ventral epidermis, mostly smooth, some tuberculate, ± 25 μm wide. *Scales* hyaline, small and inconspicuous, 600 × 325 μm, fragile, situated ventrally toward the apex, spaced (Figures 2F; 3D), cells ± 75 × 50 μm, 4–6-sided. *Antheridia* numerous along groove, with conspicuous, hyaline necks, up to 500 μm long. *Archegonia* with purple necks, scattered along length of lobes in female plants. *Sporangia* bulging slightly dorsally, up to 700 μm wide, containing 900–1 200 spores each. *Spores* (60–) 65–80(–85) μm in diameter, pale yellow-brown, semi-transparent, triangular-globular, polar, with wing up to 10 μm wide, perforated at marginal angles and occasionally also elsewhere, margin finely crenulate; distal (outer) face with ± 4 large, central areolae, 15–20 μm wide, some with central boss (Figure 4B, D, E), outer areolae smaller, 5–12 μm wide, walls extending across wing; proximal (inner) face with triradiate mark distinct (Figure 4C), suture ridges ± 5 μm high and extending on to wing, areolae 5–10 μm wide (Figure 4A, C), angular, walls raised at nodes, often irregular and incompletely separating the areolae. (The size and ornamentation of the spores were quite variable when comparing the two gatherings, *S.M. Perold 2338* and *1830*, from the same site (Figure 4A, B & 4C–E respectively), the former having been collected during drought, when the spores were smaller and more numerous in each sporangium; the latter were collected during good rains. *Chromosome number* n = 9 (Bornefeld pers. comm.).

Riccia hantamensis is one of several species which have a dorsal epithelium consisting of free cell pillars and hence it is classified in section *Pilifer* Volk. It is closely related to, but distinguished from *R. alatospora* Volk & Perold, mainly on account of its robust size. In addition, the apical cells of its free dorsal epithelial pillars are more rounded and the inconspicuous scales are hyaline and occur ventrally only near the apex (Figure 3D), in contrast to the red scales present along most of the length of the flanks in *R. alatospora*. The somewhat wider 4–6–8-sided air canals in the assimilation tissue and the wide-winged spores with their very distinctive ornamentation, are characters shared by both species, but the spores of *R. hantamensis* are smaller in diameter (Figure 4F), and far more numerous in each sporangium. The chromosome number for *R. hantamensis* is n = 9, in comparison with n = 8 in *R. alatospora*, but this may be of less significance as more than one karyotype is known in some species (Volk *et al.* 1988).

Although the spore ornamentation of the two species is very similar, the differences in thallus morphology mentioned above, warrant recognition of *R. hantamensis* at specific level. Cultures of the two species which were maintained side by side in a Petri dish for nine months, retained the differences in size and morphology. Both species are probably derived from a common ancestor,

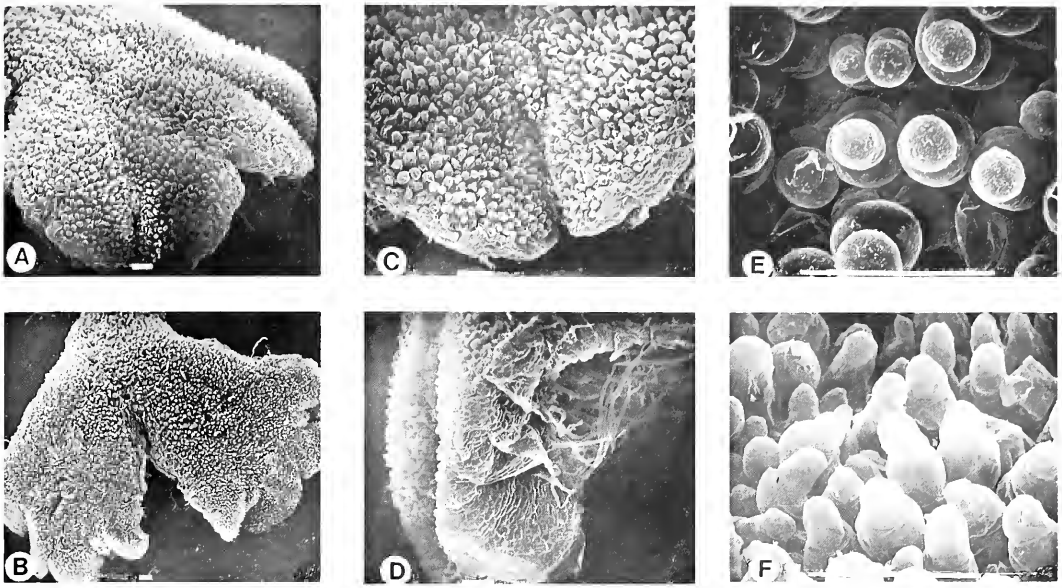

FIGURE 3.—*Riccia hantamensis*. Morphology and anatomy. A, dorsal view of thallus, branches once furcate; B, branches twice furcate; C, apex of thallus from above; D, ventral scales and rhizoids shown from side; E, dorsal cells and air pores from above; F, dorsal cell pillars partly from the side. A–F, *Germishuizen 4034*. Scale bars on A–F = 100 μm.

as indicated by similarities in the more conservative sporophyte.

Specimens examined

CAPE.—3119 (Calvinia): Hantams Mountain, Van Rhynshoek Farm (–BD), 1986 October, *G. Germishuizen 4034* (PRE); 1987 October, *S.M. Perold 1830* (PRE) (see type); 1988 September, *S.M. Perold 2338* (PRE).

A NEW RECORD OF *R. ALATOSPORA* VOLK & PEROLD

Until now, this species was known only from Platklip, Stellenbosch, where it was first collected by Duthie in 1929. Two more collections of *R. alatospora* were recently made (Figure 1):

CAPE.—2918 (Gamoep): Carolusberg, Hester Malan Res. (–CA), *S.M. Perold 1425* p.p., *1426* (PRE).

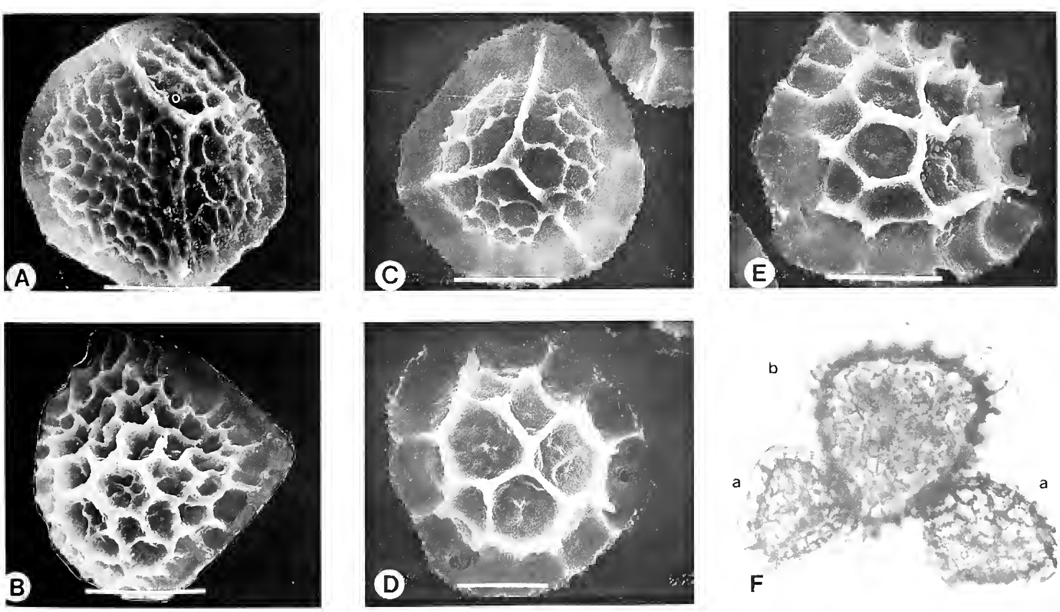

FIGURE 4.—*Riccia hantamensis* and *R. alatospora*. Spores. A–Fa, *R. hantamensis*; Fb, *R. alatospora*. A, C, proximal face; B, D, distal face; E, distal face, partly from the side; A–E, SEM micrographs; F, LM (light microscope) micrograph. A, B, Fa, *S.M. Perold 2338*; C–E, *S.M. Perold 1830*; Fb, *Duthie 5004*. Photography by S.M. Perold. Scale bars on A–E = 50 μm; diameter of Fb ± 120 μm.

ACKNOWLEDGEMENTS

I wish to sincerely thank Mr G. Germishuizen, BRI, Pretoria, for collecting the first specimen of this new species and for proposing the specific epithet; also Dr T. Bornefeld, Am Reelein 1, Höchberg, F.R.G. for doing the chromosome counts and Prof. (emer.) Dr O.H. Volk, Würzburg for his advice and fruitful discussions. I am most grateful to Dr H.F. Glen, BRI, for the Latin diagnosis and to Mr J. van Rooy for correcting the text.

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VOLK, O.H., PEROLD, S.M. & BORNEFELD, T. 1988. Studies in the genus *Riccia* (Marchantiales) from southern Africa. 10. Two new white-scaled species of the group 'Squamatae': *R. argenteolimbata* and *R. albornata*. *Bothalia* 18: 155–163.

Bothalia 19,2: 161–165 (1989)

Studies in the genus *Riccia* (Marchantiales) from southern Africa. 14. *R. concava* section *Pilifer*

S.M. PEROLD*

Keywords: Marchantiales, *Riccia concava*, section *Pilifer*, southern Africa, taxonomy

ABSTRACT

A historical account is given of the confusion caused by the application of the name *R. concava* to various taxa. A new description of the species as understood by the author is given and a comparison made with related species. Its distribution and ecology are noted.

UITTREKSEL

'n Historiese oorsig van die verwarring veroorsaak deur die toepassing van die naam *R. concava* op verskeie taksons word gegee. 'n Nuwe beskrywing van die spesie, volgens die begrip van die skrywer, word weergegee en 'n vergelyking word met verwante spesies getref. Die ekologie en verspreiding word ook vermeld.

R. concava was initially named by Bischoff (in MS) and described by Gottsche, Lindenberg & Nees ab Esenbeck (1844) from a specimen collected by Krauss in 1838, on decomposing granite, at the Cape of Good Hope. They placed it in their group C, 'Subtus Squamatae', noting that the fronds were glaucous on both sides, becoming whitish when dry, fan-shaped, narrowly canaliculate, 2–4-lobed, occasionally nearly in rosettes, the lobes ovate, obtuse or emarginate, concave in the dry plant, mussel-shaped, with raised margins and underneath, toward the apex, with scales. To them, it was among the biggest species in the genus, with distinctive lobes in the dry plant. Then there follows a rather puzzling observation in that, according to Bischoff (in litt.), the small scales of the dry plant, when casually observed, could be taken for cilia. This is difficult to correlate with the type material as there is no similarity between these scales and cilia, unless Bischoff possibly mistook the dorsal cell pillars towards the margins for cilia, although in the dry state, they would have collapsed and been less visible. Gottsche *et al.* compared it with *R. albomarginata* and with *R. lamellosa*, but observed that in *R. concava* the lobes were ovate and very concave and the scales were only visible at the apex.

The type specimens held at G and S are fragmentary, of poor quality and have probably been pressed. The width of the widest branch is 3,25 mm, segments are 4 mm long and the branches up to 7 mm long, the margins are partly inflexed and the flanks here and there have faint purple colouring; the dorsal cells have collapsed and cannot be measured; a scale from the apex is 850×250 μm, cells in the body of the scale are oblong-hexagonal, up to 125×62 μm, with smaller cells at the margin. There are no spores. Enclosed with the isotype specimen (G) and mounted between two cover-slips, is a dried transverse section of a thallus branch (by Lindenberg); it is 1,75 mm wide and 0,65 mm thick, with the dorsal cells collapsed, the upper surface is ± concave, the flanks ± rounded and the margins slightly raised and subacute.

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Stephani (1898) originally placed *R. concava* in his Inermes (i.e. without cilia) group IV, but after examining the 'original' plant, transferred it to his group VII (Frons Crassa). He, however, expressed doubts that the plant had been sufficiently studied by Gottsche *et al.*, because they had compared it with *R. albomarginata* which has thin lobes and with *R. lamellosa*, which is fleshy. In his *Icones hepaticarum* (Stephani 1876–1907) (G, M), two widely different cross sections of the thalli of *R. concava* are illustrated, one very thin and slightly concave, with acute, winged margins and the other thicker and concave, with obtuse margins. He also described the scales as large and extending above the thallus margins.

In important aspects, Sim's (1926) description is not correct: these plants do not truly grow in rosettes, nor did he make any mention of the loose dorsal cell pillars, only noting that there are 'upright pillars of lax, chlorophyllose cells with a larger globose epidermal cell on each'. Furthermore, he stated that the spores, 80 (not 8) μm in diameter, are 'laxly reticulated with about 5 areolae on the diameter each way'. Both these characters, viz. a single globose dorsal cell and only about 5 areolae across the diameter of the spore, suggest a different species altogether.

Duthie and Garside did not publish anything on *R. concava*; a note of Duthie's was found with a *Potts* specimen, *CH1010*, to the effect that she was not at all sure of the differences between *R. albomarginata* and *R. concava*. There are, however, several very good Duthie collections of *R. concava* (and presumably named by her) at BOL and S, notably *Duthie 5005*.

Arnell's (1963) description may have been based on the correct species, but he did not cite any specific collections, so this can only be checked on specimens named by him; however, here the dorsal cells can no longer be examined reliably and the spore ornamentation, as stated below, is somewhat variable. The width at 1,5 mm, which he reported for the thallus is rather narrow, but the colour, 'glaucous-yellow green', is correct, although also applicable to other species. The inflated dorsal cells are not correctly illustrated, as they are longer than wide and

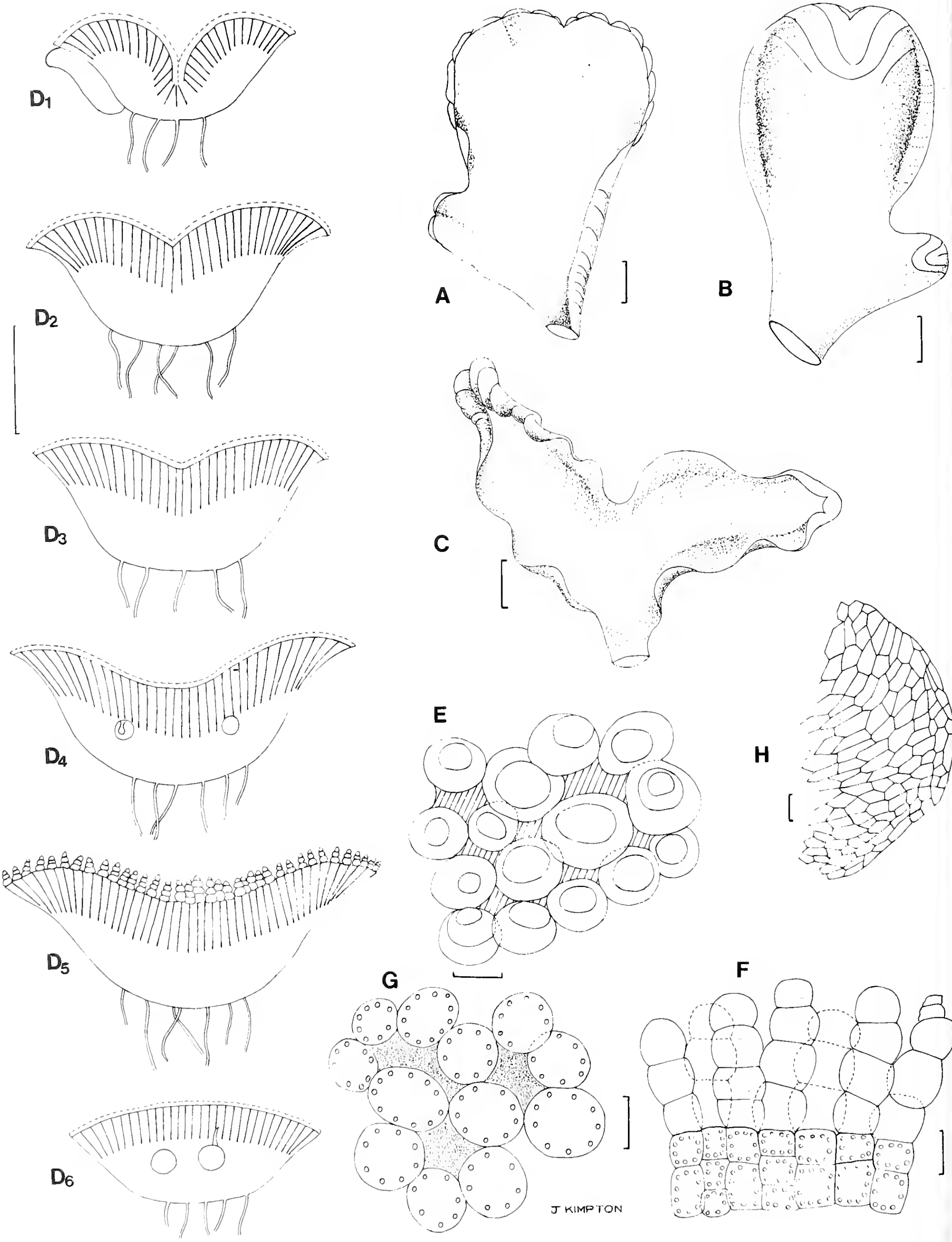

FIGURE 1.—*Riccia concava*. Morphology and anatomy. A, fresh thallus, dorsal view; B, fresh thallus, ventral view; C, dried thallus; D1–6, transverse sections of thallus branch at different distances from apex to older parts; E, epithelial cells and air pores (hatched) from above; F, transverse section through dorsal epithelial cell pillars; G, paradermal section through assimilation tissue; H, scale. A, B, D, *S.M. Perold 1431*; C, *S.M. Perold 1899*; E, H, *Morley 214*; F, *S.M. Perold 1447*; G, *Moll 6015*. Drawings by J. Kimpton. Scale bar on A–D = 1 mm; E–G = 50 μm; H = 100 μm.

partly collapsed, whereas the 'hairlike cell pillars' at the margin, are the scale cells in cross section; spores with thick ridges radiating from the centre as drawn by him, is not a character unique to *R. concava*. As also concluded by Volk (1981), it appears highly probable that Sim and Arnell did not describe the same species.

The specimens Arnell referred to *R. concava* at PRE and S have been examined; some have certainly been correctly determined, but others doubtfully so (see Specimens examined). It seems likely that he lumped together as *R. concava* all those species with loose dorsal pillars (described by him as velvet-like), which he could not refer to either *R. albomarginata* sensu Sim or to *R. villosa*. That this is so, is also suggested by the wide distribution he claimed for it (see below).

Riccia concava *Bisch.* in Gottsche, Lindenberg & Nees ab Esenbeck, Synopsis hepaticarum: 604 (1844); Stephani: 325, 378 (1898); Sim: 12 (1926); Arnell: 22 (1963).

TYPE.—Cape, in Capite Bonae Spei locis humidis, in saxis graniticis decompositis. *Krauss s.n.*, 1838 (*G8978* in G, iso.!) ex Herb. Musci. Palat. Vindob.; (S, iso.! fide Grolle 1976: 226) ex Herb. Lehmannianum.

Thallus monoicous, perennial, in crowded gregarious patches, not truly in rosettes (Figure 2A); blue-green (to ± yellowish green when actively growing), becoming whitish along margins, with scales not, or hardly protruding, except at apex where visible from above, also when wet and fully expanded (Figure 1A); medium-sized to large, branches once or twice furcate, rarely simple; medium to widely divergent, 6–8(–10) mm long, 3–4 mm wide, 0,9–1,2 mm thick, i.e. 3–4 times wider than thick in section, broadly ovate to obovate, apex rounded, emarginate, dorsally deeply grooved toward apex (Figure 2B–D), sides convex, soon becoming flat to slightly concave proximally, margins acute to subacute, shortly winged, somewhat recurved, flanks sloping obliquely upward and outward (Figure 1D1–6), ± arched, pale mauve to dark purple, covered by scales; ventral surface rounded, green to purple laterally (Figure 1B); when dry, glaucous to blue-green or mauvish green, scurfy or flaky, dorsally markedly concave, margins raised and incurved, partly inflexed (Figure 1C), occasionally almost meeting, exposing flanks clothed with wrinkled, mostly dull whitish to pale cream-coloured scales, basally often with mauve streaks across or with purple sheen from dark purple flanks underneath.

Anatomy of thallus: dorsal epithelium consisting of 3(–4)-celled, free-standing, hyaline pillars (Figure 2E, F), ± 180–260 μm long, top cell smallest, globose or conical, 35–42 × 45–60 μm, frequently collapsed, second cell usually wider and inflated, 50–62 μm long and up to 85 μm wide, basal cell(s) ± rectangular, 50–75 × 68–75 μm (Figure 1F); on dorsal face seen from above, cells in apical parts closely packed, inflated, shiny, like small round glass beads, in rows, cells in basal parts less orderly arranged and collapsing; air pores small, 4–5-sided (Figure 1E); assimilation tissue ± 450 μm thick in section, occupying almost ½ the thickness of thallus and consisting of vertical columns of 6–8 short-rectangular cells, up to 55 × 43 μm, enclosing narrow 4–5-sided air canals (Figure 1G); storage tissue ± 300 μm thick, ± ⅓ (or less) the thickness of thallus, cells crowded together, round to angular, 55–62 μm wide; rhizoids arising from ventral epidermis ± 20 μm wide, some smooth, others tuberculate. *Scales* semicircular, imbricate, hyaline, not or hardly extending beyond thallus margins except at apex, mostly ventrally situated along concave flanks, 900–1 200 × 600 μm, cells in body of scale long rectangular, or 5–6-sided, up to 160 μm long × 50–65 μm wide, walls straight, at scale margin one row of smaller cells, wider than long (Figure 1H). *Antheridia* with hyaline necks ± 250 μm long, in 2 rows along middle of lobes. *Archegonia* with purple necks. *Sporangia* ± 500 μm wide, single or in pairs, each with ± 350 spores, bulging dorsally, overlying tissue disintegrating and liberating spores. *Spores* 75–90(–100) μm in diameter, triangular-globular, polar, dark brown, with narrow wing up to 5 μm wide, angles notched or with a pore, margin finely crenulate; ornamentation somewhat variable, reticulate to vermiculate, or with radiating ridges: distal face with 10–14 deep-set areolae across the diameter, up to 7,5 μm wide, some with a central papilla, radial walls thick (Figure 3C), often dusted with granules (Figure 3D), usually raised at nodes, occasionally forming short, irregular ridges radiating outwards from centre (Figure 3E, F); proximal face with triradiate mark quite prominent, sparsely granular, numerous (30–40) small round areolae on each facet, walls raised at nodes (Figure 3A, B). *Chromosome number* n = 8 (Bornefeld (1984) on *S.M. Perold 470, 485*).

R. concava can be distinguished from the other species in section *Pilifer* Volk (1983), by its broad thallus, up to 4 mm wide when fully expanded, concave when dry, glaucous or scurfy blue-green colour, rounded apex, somewhat overhanging margins mostly obscuring the scales except those at the apex, and fragile, inflated, generally wider than long dorsal cells in loose pillars. On exposure to bright sunlight, it develops a deeper purple colour at the flanks and ventrally.

In this section, most of the other species, currently totalling ± 12 species and some still to be described, have conspicuous hyaline scales, except for *R. alatospora* Volk & Perold (1985) and *R. hantamensis* Perold (1989). In *R. albomarginata* sensu Sim [the name has been misapplied since Sim (1926)—Perold in prep.], the dorsal cell pillars tend to be more persistent, tall and narrow with all the basal cells ± equally long; *R. villosa* is easily recognized by large, triangular scales and papillose spores; *R. parvo-areolata* Volk & Perold (1984) has spores with numerous small areolae; the rest of the species have tapering or uniform pillars with cells that are generally longer than wide. To examine the dorsal cells, living material is required, as they cannot be reconstituted in long-dried herbarium material.

Differences in the spore ornamentation between *R. concava*, *R. albomarginata* Bisch. ex G.L. & N., and one or two new, as yet undescribed species in the section, are sometimes quite difficult to discern, even on SEM micrographs, nor are radiating ridges on the distal face altogether distinctive. Moreover, the spores of *R. concava* can be quite variable, even when from the same sporangium.

R. concava often grows in association with other *Riccia* species of section *Pilifer* and with the moss species

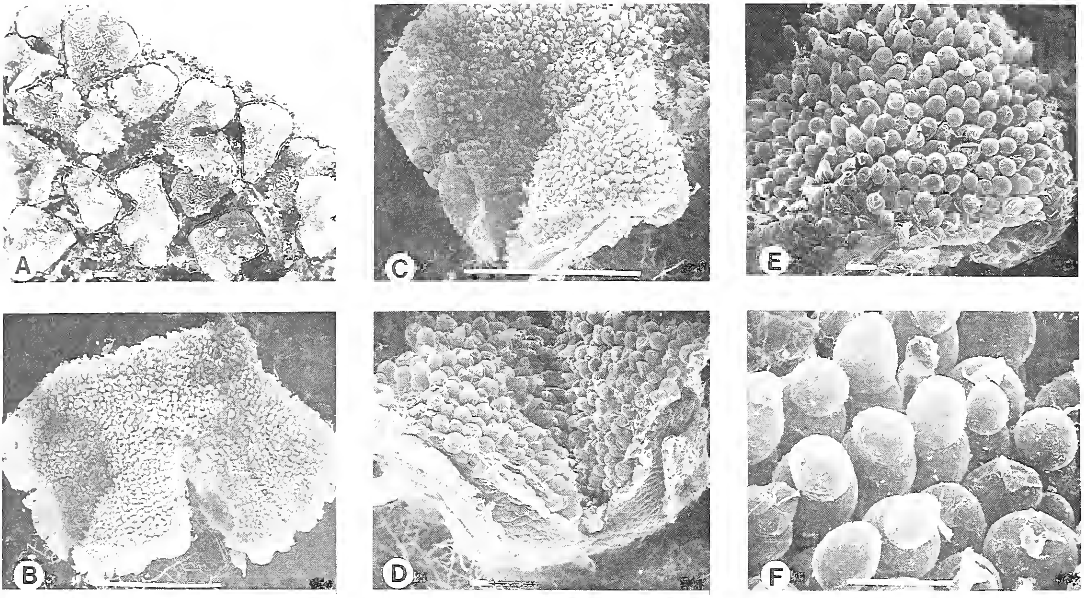

FIGURE 2.—*Riccia concava*. Morphology and anatomy. A, thalli not in rosettes; B, dorsal view of thallus; C, D, apex with dorsal groove; E, F, dorsal cell pillars. A–F, *S.M. Perold 2312*. Scale bar on A–C = 1 mm; D–F = 50 μm.

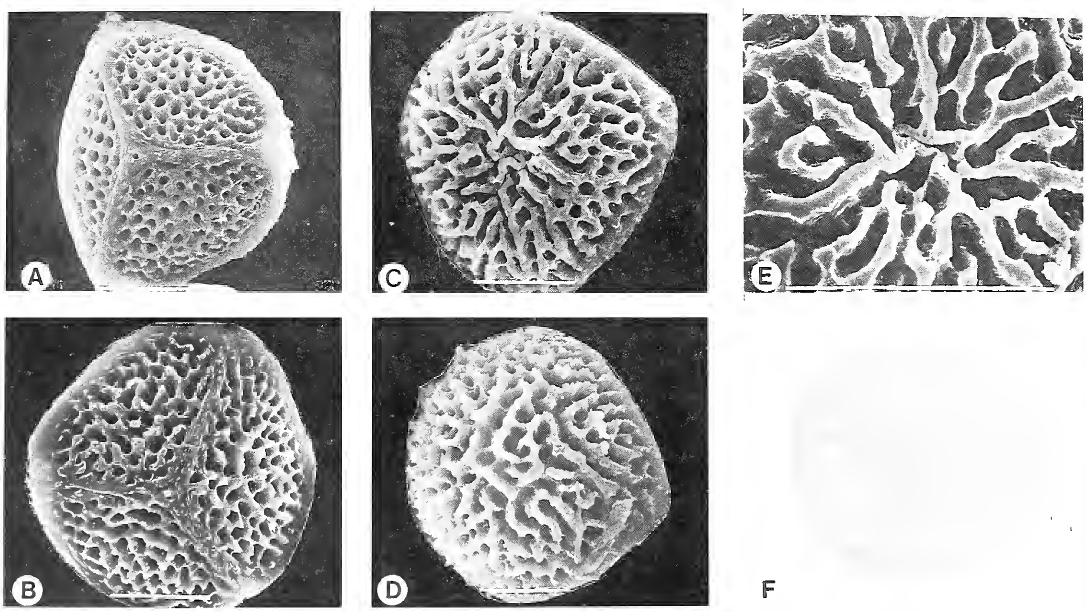

FIGURE 3.—*Riccia concava*. Spores. A, B, proximal face; C, D, F, distal face; E, radiating ridges on distal face. A, *S.M. Perold 2313*; B, *S.M. Perold 1791*; C, *S.M. Perold 1500*; D, *S.M. Perold 1773*; E, F, *Garside 6128*. Photography by S.M. Perold. Scale bar on A–E = 50 μm; diameter of spore on F, ± 90 μm.

Barbula crinita Schultz, *Desmatodon convolutus* (Brid.) Grout and *Chamaebryum pottioides* Thér. & Dix. It prefers damp, not wet places, being found away from seepages, on sandy, well drained soil overlying granite outcrops. It is fairly common in the north-western, western, south-western and southern Cape Province (Figure 4). Besides the western Cape, Sim (1931) and Arnell (1963) also reported it from Natal, Transvaal, S Rhodesia, Portuguese East Africa, Madagascar and the Canary Islands, but this has not been verified (see below). (At PRE, a Sim specimen from Magude, P.E.A. [Mozambique] has been identified as *R. concava*, but it has black scales.)

Arnell's specimens, *Arnell s.n.*, 11.3.59 (*UPS 20635*) (Lagunetas); 13.3.59 (*UPS 20636*) (Cueva Grande) and 28.2.59 (*UPS 20637*) (La Calzada) from the Canary Islands, which he named *R. concava*, do not belong here, as the shape of the thalli in transverse section, the width to thickness proportions and the spore ornamentation with fewer and larger areolae on the dorsal face and granules

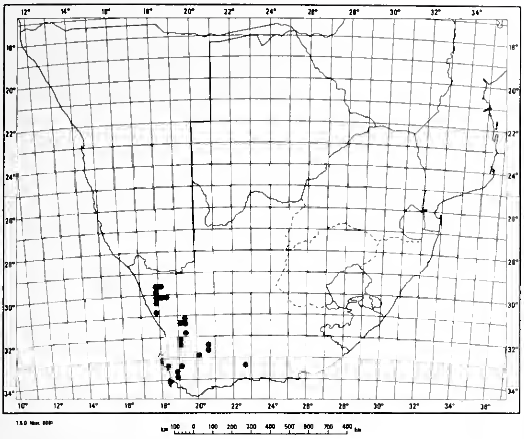

FIGURE 4.—Distribution map of *Riccia concava* in southern Africa.

on the proximal face, do not correspond with those of *R. concava*. It should be deleted from the species list of the Macaronesian Islands (Arnell 1961; Düll 1984; Eggers 1982; Sergio 1984). These plants do, however, belong to section *Pilifer* Volk, which is unique to southern Africa, except for the above, and for specimens from Île de l'Est (Crozet Archipelago), assigned to *R. albomarginata* by Jovet-Ast (1986). Unfortunately the identity of Arnell's specimens from Gran Canaria is still uncertain and will probably remain so, unless fresh material can be collected. Regardless of which species of section *Pilifer* they belong to, their original dispersal from southern Africa to Macaronesia, whether by man or by migrating birds, is highly probable.

SPECIMENS EXAMINED

CAPE.—2917 (Springbok): Springbok, opposite Country Club, rock outcrops (−DB), *S.M. Perold 1414, 1415* (PRE); 14 km N of Springbok at edge of large granite dome (−DB), *S.M. Perold 2054, 2057* (PRE); S of Springbok, 6 km from Kokerboom Motel on road to Kamieskroon (−DD), *S.M. Perold 1438* (PRE). 2918 (Gamoep): Carolusberg, near gate (−CA), *S.M. Perold 1431, 1432* (PRE). 3017 (Hondeklipbaai): 2 km N of Kamieskroon, granitic rock outcrops (−BB), *S.M. Perold 1447, 1454, 1455, 2091, 2094* (PRE); Kamiesberg Pass, drier area above seepage (−BB), *S.M. Perold 1604* (PRE); Rietkloof, 14 km S of Kamieskroon, edge of rock outcrop (−BD), *S.M. Perold 2103–2105* (PRE); Brakdam, 31 km S of Kamieskroon, rock outcrops (−BD), *S.M. Perold 2113, 2115* (PRE). 3018 (Kamiesberg): 18 km NE of Kamieskroon, on road to Rooifontein (−AA), *S.M. Perold 1460, 1465, 1466* (PRE); 4−5 km along road to Rooifontein, from Kamieskroon-Leliefontein road (−AA), *S.M. Perold 2148, 2172, 2173* (PRE); Pedroskloof, on road to Rooifontein (−AA), *S.M. Perold 1493* (PRE); Kamassies, large rock outcrop (−AB), *S.M. Perold 1500, 1501* (PRE). 3119 (Calvinia): E of Slagberg, between Nieuwoudtville and Loeriesfontein, Farm Koringhuis (−AB), *S.M. Perold 1795, 1798* (PRE). Nieuwoudtville, sandstone outcrops 2 km SW of town (−AC), *S.M. Perold 2195* (PRE); Nieuwoudtville Falls (−AC), *S.M. Perold 1788, 1791, 1792, 2312, 2313, 2316* (PRE); Nieuwoudtville, Farm Oorlogskloof (−AC), *C.M. van Wyk 1493* (PRE); Van Rhyns Pass, in ditch on plateau (−AC), *S.M. Perold 2185* (PRE); Groothoek, 18 km on dirt road to Rondekop, Soetlandsfontein River (−AD), *S.M. Perold 1773* (PRE). 3219 (Wuppertal): Biedouw Youth Camp, sandstone rock outcrops (−AA), *S.M. Perold 1888* (PRE); Algeria Forest Station, 4 km S of streambank (−AC), *S.M. Perold 2362* (PRE). 3220 (Sutherland): near Sutherland (−BC), *Duthie 5407* (BOL); Montagu, Bath Kloof (−CC), *Arnell 753* (BOL, S); Klein Roggeveld, De Kom, clay soil over shale (−DA), *Oliver 8949* (PRE); Haashoogte, damp E slope (−DA), *Oliver 8957a* (PRE); 50 km S of Sutherland, 21 km along road to Wolfhoek, Farm Bergsig, streambank (−DA), *S.M. Perold 2426, 2427* (PRE). 3318 (Cape Town): Darling, 5 km S of, (−AD), *S.M. Perold 485* (PRE); Lion's Head above Fresnaye (−CD), *Arnell 12a, 67a* (BOL); Signal Hill (−CD), *Garside 6128* (BOL); Wellington (−DB), *Duthie 5470* (BOL); Stellenbosch, clayey ground below municipal farm near railway line (−DD), *Duthie 5005* (BOL, S); railway embankment (−DD), *Duthie 5417* p.p. (BOL); E end of Stellenbosch Flats near farm, on earth bank of sloot (−DD), *Garside 6108* (BOL); Stellenbosch, Platklip (−DD), *Morley 214* (PRE), *S.M. Perold 470* (PRE); Stellenbosch, Papegaaiberg (−DD), *S.M. Perold 478* (PRE). 3319 (Worcester): Tulbagh (−AC), *Duthie 5468* (BOL). 3322 (Oudtshoorn): Meiringspoort, on disturbed soil at roadside (−BC), *S.M. Perold 899* (PRE).

Only specimens which unequivocally could be referred to *R. concava*, have been included in the above list. New collections have all been cultivated and observed over a period of time. If there was the slightest element of doubt about the identity of old collections from the western and south-western Cape Province, that had been named by Duthie and by Garside, or by Arnell, they have been excluded.

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Bothalia 19,2: 167–174 (1989)

New taxa, combinations and records of Pteridophyta from southern and central Africa

J.E. BURROWS*

Keywords: central Africa, new records, new taxa, Pteridophyta, southern Africa

ABSTRACT

Four new taxa of ferns are described and illustrated from southern Africa: *Ophioglossum* **convexum** J.E. Burrows, *Mohria caffrorum* (L.) Desv. var. **ferruginea** J.E. & S.M. Burrows, *Marsilea farinosa* Launert subsp. **arrecta** J.E. Burrows and *Asplenium* **sebungweense** J.E. Burrows. The combination of **Grammitis rigescens** (Bory ex Willd.) J.E. Burrows is made. *Ophioglossum thomasii* Clausen, *O. rubellum* Welw. ex A. Braun, *Vittaria ensiformis* Swartz and *Asplenium buettneri* Hieron. ex Brause are new records for Zimbabwe, while *Hymenophyllum splendidum* V.d. Bosch and *Asplenium uhligii* Hieron. are new records for Malawi and Zimbabwe. *Actiniopteris semiflabellata* Pichi-Sermolli is recorded from Namibia and *Thelypteris oppositiformis* (C. Chr.) Ching is recorded from the Transvaal.

UITTREKSEL

Vier nuwe varingtaksons van suidelike Afrika word beskryf en geïllustreer: *Ophioglossum* **convexum** J.E. Burrows, *Mohria caffrorum* (L.) Desv. var. **ferruginea** J.E. & S.M. Burrows, *Marsilea farinosa* Launert subsp. **arrecta** J.E. Burrows en *Asplenium* **sebungweense** J.E. Burrows. Die kombinasie **Grammitis rigescens** (Bory ex Willd.) J.E. Burrows word gemaak. *Ophioglossum thomasii* Clausen, *O. rubellum* Welw. ex A. Braun, *Vittaria ensiformis* Swartz en *Asplenium buettneri* Hieron. ex Brause word die eerste keer in Zimbabwe aangeteken, terwyl *Hymenophyllum splendidum* V.d. Bosch en *Asplenium uhligii* Hieron. die eerste keer in Malawi en Zimbabwe aangeteken word. *Actiniopteris semiflabellata* Pichi-Sermolli word in Namibië aangeteken en *Thelypteris oppositiformis* (C. Chr.) Ching word in die Transvaal aangeteken.

INTRODUCTION

While carrying out research on southern African pteridophytes, it became obvious that there were a few undescribed taxa from, as well as a number of new records to, the area covered by *Flora zambesiaca* and *Flora of southern Africa*, several being interesting southern extensions of tropical species. This paper attempts to update our knowledge of southern African ferns in the light of recent collections and research.

1. **Ophioglossum thomasii** *Clausen* in Memoirs of the Torrey Botanical Club 19: 152 (1938). Type: Uganda, Kampala, Kabaka's Lake, *Thomas 1903* (BM, holo.!).

ZIMBABWE.—2028: Matopo Hills, Besna Kobila Farm, 1 465 m, Jan. 1956, *Miller 3305* (PRE!).

Distribution: Liberia, Ivory Coast, Ghana, Nigeria, Cameroon, Gabon, Zaïre, Uganda, Tanzania and Zambia.

2. **Ophioglossum convexum** *J.E. Burrows*, sp. nov.

Rhizoma elongatum, 5–25 mm longum cum vel sine aliquot basibus petiolorum persistentibus. *Radices* proliferae. *Folium* unum (raro duo), ad angulum 0–30° portatum vix supra vel terram adpressum. *Petiolus* 6–25 mm longus, 60–90% longitudinis subterraneus. *Lamina sterilis* desuper convexa, ovata vel late ovata, late acuta vel obtusa et breviter apiculata; basis late cuneata vel truncata; nervatura obscura. *Spica fertilis* 30–100 mm longa, ad vel vix infra basin laminae sterilis inserta; sporangia paribus 6–15; apex acutus vel breviter apiculatus.

TYPE.—Transvaal, 2530 (Lydenburg): Coromandel Farm (–AD), *Burrows 3683* (PRE, holo.; BOL, K, iso.).

Rhizome elongate, 5–25 mm long with or without a few persistent petiole bases. *Roots* proliferous. *Leaves* one, rarely two, held at 0–30° from the horizontal, just above or appressed to the ground. *Petiole* 6–25 mm long, 60–90% of its length subterranean. *Sterile lamina* convex above, ovate to broadly ovate, broadly acute to obtuse and shortly apiculate, base broadly cuneate to truncate, venation obscure. *Fertile spike* 30–100 mm long, inserted at, or just below, the sterile lamina base, 6–15 pairs of sporangia, apex acute to shortly apiculate. Figure 1.

ZAMBIA.—0830: Abercorn District, ± 2,4 km above Sansia Falls, Kalambo River, *Richards 10371* (?K) [Schelpe 1970: 35 as *O. rubellum*].

ZIMBABWE.—1731: Ngomakurira Mtn, Chindamora, 1 430 m, *Burrows 3040* (BOL, K, SRGH), *3046* (Herb. Burrows); *Mavi 1601* (SRGH).

TRANSVAAL.—2530 (Lydenburg): Lydenburg, Lisabon State Forest (–BC), *Burrows 3427* (PRE, Herb. Burrows). 2430 (Pilgrim's Rest): Pilgrim's Rest, New Chum Falls (–DB), *Roberts 102* (BOL!).

MADAGASCAR.—Grid ref. unknown: Boina, *Perrier 7694* (P!) [*O. nudicaule* L. f. sensu Tardieu-Blot 1951].

REUNION.—2155: Chemin des Anglais, *Cadet 956, 1203, 1258* (P!) [all as *O. nudicaule* L. f.].

Within all the populations seen of *O. convexum* there are large numbers of plants that do not bear fertile spikes. These plants all have the lamina appressed flat on the ground although those plants that carry a fertile spike appear to have a petiole that raises the lamina 2–3 mm above the ground, with the lamina typically held at ± 30° from the horizontal.

O. convexum is closely related to *O. rubellum* Welw. ex A. Braun (Figure 2) but differs from it in having a longer

* Buffelskloof Nature Reserve, P.O. Box 236, Lydenburg 1120.
MS. received: 1988.11.25.

FIGURE 1.—*Ophioglossum convexum* J.E. Burrows, in natural habitat, Lisabon State Forest, Lydenburg, Transvaal, *Burrows 3427.*

and narrower rhizome, only a single leaf (*O. rubellum* almost always has two or more), and in having the leaf appearing convex from above with the margins generally curving downwards although the midrib region may be concave, while the leaf of *O. rubellum* appears folded along the midrib, sloping upwards to the margin and is never appressed to the ground, being held at 10–20° from the horizontal. There are a number of collections of plants identified as *O. rubellum* from east and central Africa which have a single leaf and are stated to have the lamina lying flat upon the ground which are undoubtedly *O. convexum*. The confusion has almost certainly arisen from a misinterpretation of Welwitsch's type from Angola which is in Kew (isotype in BM). On the three sheets (two in K, one in BM), there are a total of 41 plants, of which six bear a single leaf, 29 with two and six with three leaves. Schelpe (1970) states that *O rubellum* has a single leaf, quoting and illustrating a plant collected from Zambia (*H.M. Richards 10371* — said to be in Kew but not found by the author) that is clearly *O. convexum*. It is likely that this error has been perpetuated elsewhere in Africa.

O. convexum is also similar to *O. nudicaule* L. f. (Figure 3). *O. nudicaule* sens. strict. is, in the author's opinion, confined to the Cape Province and has up to five leaves per plant, each leaf being concave when viewed from above, with the whole lamina somewhat deflexed. Like most species of *Ophioglossum, O. convexum* does not appear to be closely linked to climate or altitude, occurring in the Transvaal in montane grassland at altitudes of between 1 200 and 1 900 metres, but in warmer climates and at lower altitudes north of the Limpopo River (Figure 4). Proliferating roots as found in this species are not unusual in the genus, although they are seldom documented (Chen & Chiang 1972). Due to its proliferous roots the species tends to form colonies of several square metres.

3. **Ophioglossum rubellum** *Welw. ex A. Braun* in Kuhn, Filices africanae: 179 (1868). Type: Angola, Pungo Andongo, *Welwitsch 33* (K, holo.!; BM, iso.!).

Icon: Tardieu-Blot: pl. 1, fig. 8 (1953).

Specimens collected on seasonally wet sandy soils in the Sengwa Wildlife Research Area lack the reddish tinge that gave the specific name to the type collection, but in all other characters are identical to Welwitsch's plants examined by the author. There are collections from Zambia, Kenya and Ethiopia that have smaller, single leaves with a bluish tinge that have been attributed to *O. rubellum* but they may in fact be *O. convexum* J.E. Burrows (Figure 1), or an undescribed species. (See also notes under the previous species.)

ZIMBABWE.—1828: Gokwe, Sengwa Wildlife Research Institute, 0,5 km NE of bridge over the Sengwa Gorge, 880 m, 12.2.1983, *Burrows 3019* (BOL, K, PRE, SRGH, Herb. Burrows). Figure 2.

Distribution: Ethiopia, Kenya, Uganda, Tanzania, Zambia and Angola.

4. **Mohria caffrorum** *(L.) Desv.* var. **ferruginea** *J.E. & S.M. Burrows*, var. nov., a var. *caffrorum* rhachidi juventute perdense squamis atroferrugineis obtecta differt.

TYPE.—Natal, (2929) Underberg: Drakensberg Mts, Injasuti, below Women Grinding Corn (–AB), *Burrows 3670* (BOL, holo.; K, PRE, iso.).

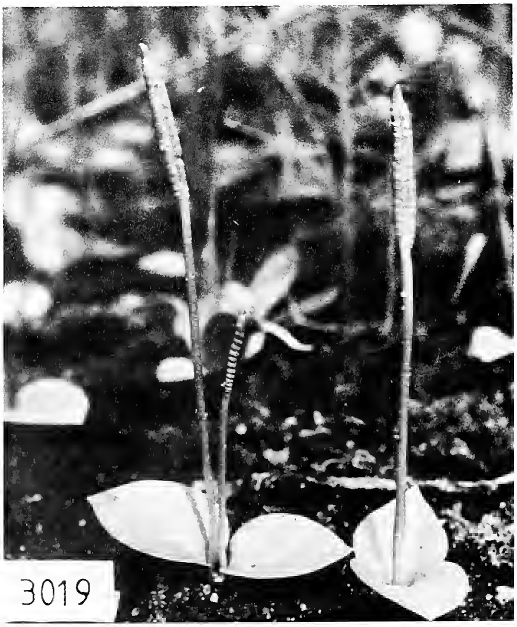

FIGURE 2.—*Ophioglossum rubellum* Welw. ex A. Braun, in natural habitat, Sengwa Wildlife Research Institute, Gokwe, Zimbabwe, *Burrows 3019.*

FIGURE 3.—*Ophioglossum nudicaule* L. f., ex hort., 14 km from Grahamstown on Cradock Road, Cape Province, *Burrows 3685*.

Rhizome erect to procumbent, 5–8 mm in diameter, with closely packed, tufted, erect fronds. *Rhizome scales* rusty brown, linear-lanceolate, attenuate, entire, concolorous, 2–6 mm long. *Stipe* 40–120 mm long, brown basally, stramineous distally when dry, variously set with dark, reddish brown, subulate, entire scales, 0,5–2 mm long, and scattered scales near the base similar to those on the rhizome, becoming subglabrous with age. *Lamina* 120–300 × 30–60 mm, narrowly elliptic to narrowly oblanceolate, with the basal pinnae decrescent, 3-pinnatifid. *Pinnae* ± 25 × 16 mm, ovate to triangular, bluntly acute. *Pinnules* oblong, obtuse, deeply pinnatifid into rounded lobes, margins widely and shallowly serrate-crenate, involute, glabrous above, with occasional, minute subulate scales below, both surfaces with scattered, opaque, linear, gland-like projections ± 0,1 mm long. *Rachis and secondary rachises* sulcate above, densely set with dark, reddish brown, subulate scales similar to those on the stipe, almost obscuring the rachis when young. *Sori* submarginal, partly covered by the involute margins (Figure 5B).

M. caffrorum var. *ferruginea* is separated from var. *caffrorum* by its thick mat of dark, reddish brown scales that clothe the rachis when young and by the glabrous to subglabrous lamina which, in old pressed fronds, turns a metallic grey. In addition, it appears to be restricted to wet situations along the margins of mountain streams and around springs, whereas var. *caffrorum* is also found on drier soils and in the shelter of boulder bases, rock cracks, as well as in scrub on the forest ecotone. Like *M. hirsuta* J.P. Roux, it appears to be restricted to high altitudes of between 1 700 and 2 300 m (Figure 6).

TRANSVAAL.—2530 (Lydenburg): Lydenburg District, Die Berg (–AA), *Burrows 3677* (BOL, PRE, Herb. Burrows); Lydenburg, Coromandel Farm (–AD), *Burrows 3679* (BOL, J, PRE).

O.F.S.—2828 (Bethlehem): Golden Gate National Park (–CB), *Roberts 3125, 3277* (PRE).

NATAL.—2828 (Bethlehem): Mont aux Sources (–DD), *Mogg 5303* (PRE). 2829 (Harrismith): Ntonjelane, Mnweni area (–CC), *Esterhuysen 14523* (BOL); Lambonja Valley, Cathedral Peak area, *Esterhuysen 12894* (BOL, PRE). 2929 (Underberg): Giant's Cup Trail, Cobham State Forest (–CB), *Nicholas & V.d. Berg 1323* (PRE); Cobham Forest Reserve, Underberg District (–CB), *Hilliard & Burtt 15935* (BOL); Tributary of Mkhomazi River, Underberg District (–CB), *Hilliard & Burtt 15731* (BOL); Bamboo Mountain, Polela District (–CB), *Doidge P.8* (PRE). 3029 (Kokstad): Mt Currie, Kokstad (–AD), *McLoughlin 771* (BOL, PRE).

LESOTHO.—2828 (Bethlehem): Leribe (–CC), *Dieterlen 475, 841* p.p. (K, MPU).

CAPE.—3227 (Stutterheim): Gxulu Mt, Keiskamma Hoek District (–CA), *Story 3502* (PRE).

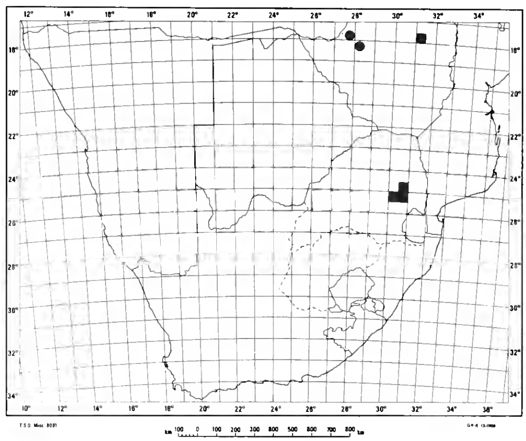

FIGURE 4.—Distribution of *Ophioglossum convexum* J.E. Burrows, ■, in the Transvaal and Zimbabwe; *Asplenium sebungweense* J.E. Burrows, ●, in Zimbabwe.

5. **Marsilea farinosa** *Launert* subsp. **arrecta** *J.E. Burrows*, subsp. nov. Differt a subsp. *farinosa* pedicellis longioribus et e basi et in axillis stipitis exorientibus sporocarpiisque ad angulum c. 180° a pedicello feruntur.

TYPE.—Transvaal, (2328) Baltimore: 40 km S of Groblersbrug on Potgietersrus road (–AA), *Burrows 3597* (BOL, holo.; J, K, PRE, Herb. Burrows, iso.).

Differs from subsp. *farinosa* (Launert 1968, 1983) in that the pedicels are longer and arise from both the base of the stipe and the axils of the stipe, and the sporocarps are held at ± 180° to the pedicels. (Figure 7B).

BOTSWANA.—2227 (Palapye): ± 10 km N of Martin's Drift on the Palapye Road (–DD), *Burrows 3715* (PRE, Herb. Burrows). 2425 (Gaberone): 3 miles north of Gaberone (–DB), *Mott 314* (BOL, PRE, UBLS). Grid ref. unknown: Content Farm, Gaberone District, *Kelaole A13* (PRE).

6. **Hymenophyllum splendidum** *V.d. Bosch* in Nederlandsch Kruidkundig Archief 5: 192 (1863). Type: Fernando Po [Bioko], *Mann s.n.* (K, ?holo.; L, iso.!).

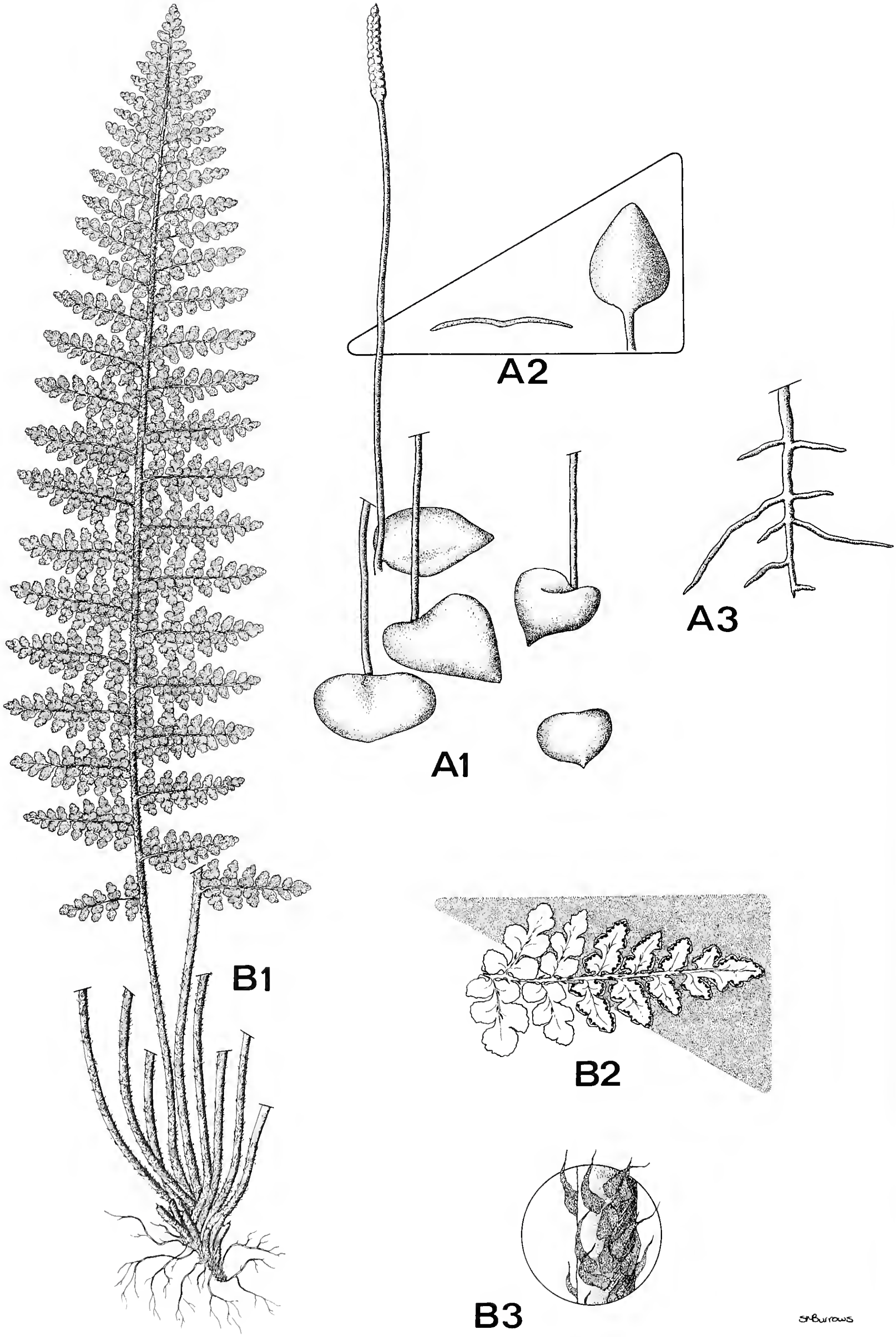

FIGURE 5.—*Ophioglossum convexum, Burrows 3683*: A1, various aspects of plants, × 1,5; A2, sterile lamina, view from above and cross-section, × 1,5; A3, rhizome, × 1,5. *Mohria caffrorum* var. *ferruginea, Burrows 3677*: B1, plant, × 0,7; B2, pinna, × 1,5; B3, rachis, × 3,5.

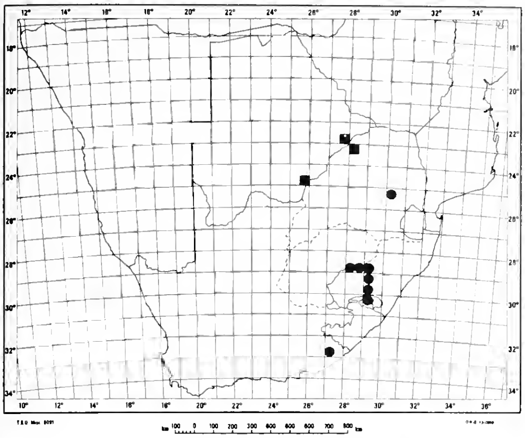

FIGURE 6.—Distribution of *Mohria caffrorum* var. *ferruginea* J.E. & S.M. Burrows, ●, in southern Africa; *Marsilea farinosa* subsp. *arrecta* J.E. Burrows, ■.

Hymenophyllum ciliatum Swartz var. *splendidum* (V.d. Bosch) C. Chr.: 368 (1906). *Sphaerocionium splendidum* (V.d. Bosch) Copeland: 31 (1938).

Hymenophyllum plumieri Hooker & Grev.: t. 123 (1829).

Icon: Tardieu-Blot: pl. IX (1964).

Whereas material recently collected by the author in both Zimbabwe and Malawi is certainly *H. splendidum*, a collection from Gúruè in Mozambique, *Torre & Correia 16899* (COI, EA, LISC, LMU, SRGH) has been determined as *H. hirsutum* (L.) Swartz. Examination of the specimen in SRGH revealed a few stellate hairs on the lamina as well as the margins and veins, making it likely that it too, is *H. splendidum*, although the ranges of the two species overlap through much of tropical Africa.

MALAWI.—1535: Mount Mulanje, below Lichenya Hut, 1 820 m, *Burrows 3746* (PRE, Herb. Burrows).

ZIMBABWE.—1832: Nyanga, eastern slopes of Mt Inyangani, 2 040 m, *Burrows 2936* (BOL, SRGH, Herb. Burrows), *3698* (PRE, Herb. Burrows).

Distribution: Cameroon, Equatorial Guinea, Bioko, São Tomé & Principe, Gabon, Zaïre, Rwanda, Burundi, Kenya and Tanzania.

7. **Vittaria ensiformis** *Swartz* in Gesellsschaft naturforschender Freunde zu Berlin, Neue Schriften 2: 134, t. 7, fig. 1 (1799). Type: Mauritius, *Sonnerat s.n.* (P).

Oetosis ensiformis (Swartz) Greene: 103 (1900).

Vittaria plantaginea Bory: 325 (1804). Type: Mascarene Islands.

Icon: Holttum: fig. 359 (1966).

V. ensiformis differs from the superficially similar *V. isoetifolia* in having broader fronds that arch out from the vertical substrate on which it grows, rather than hanging straight down, as does *V. isoetifolia*. In addition, *V. isoetifolia* has very distinctive rhizome scales with thickened cell walls and margins that bear strong, thorn-like projections, both of which are absent in *V. ensiformis*. It has been recorded growing as a low-level epiphyte on the boles of old trees in tall, semi-deciduous *Newtonia buchananii–Millettia stuhlmannii* forest, near perennial rivers, at an altitude of ± 360 m.

ZIMBABWE.—1932: Chimanimani District, Ngorima T.T.L., west bank of the Haroni R., Grid Ref. 016864, *Burrows 2737* (BOL, SRGH, Herb. Burrows); Chimanimani National Park, Mukurupini R., *Burrows 2792* (BOL, Herb. Burrows).

8. **Actiniopteris semiflabellata** *Pichi-Sermolli* in Webbia 17: 24 (1962). Type: Ethiopia, Tertale, Pozzi di El Banno, *Corradi 26* (Herb. Pichi-Sermolli, holo.; FI, iso.).

Icones: Pichi-Sermolli: fig. 4 (1962); Lawalree: pl. 1 (1969).

A plant of this fern was first collected by M. Müller of the Windhoek Herbarium in the Naukluft Mountains in 1979 and determined as *A. radiata* (Swartz) Link. Upon closer examination, it became apparent that the collection was *A. semiflabellata*, based upon the homomorphic fronds (although the fertile fronds are somewhat larger than the sterile fronds), the two types of rhizome scales (one concolorous, the other with a dark central stripe) and, most characteristically, the dried fronds which are only slightly inclined to one side, whereas in the other three African species the fan of the dried frond is bent at 90° or more from the vertical.

A. semiflabellata has, up to now, only been recorded as far south as Tanzania, Burundi and Zaïre, extending northwards to north Africa and south Asia. This find in such an isolated situation, therefore, represents an interesting and puzzling extension for the species, although the arid habitat of the Naukluft Mountains is very similar to that in which it occurs throughout much of its range.

NAMIBIA.—2416 (Maltahöhe): Naukluft, Farm Zais, on south-facing cliffs on border of farm Blässkranz, 1 400 m, (–AA), *Burrows 3737* (J, PRE, Herb. Burrows); *M. Müller 995* (WIND).

Distribution: Tanzania, Burundi, Rwanda, Zaïre, Cameroon, Nigeria, Uganda, Kenya, Sudan, Somalia, Ethiopia, Egypt, Saudi Arabia, Yemen, Socotra, Nepal, Réunion, Mauritius and Madagascar.

9. **Grammitis rigescens** *(Bory ex Willd.) J.E. Burrows*, comb. nov.

Polypodium rigescens Bory ex Willd. in Species plantarum 4: 183 (1810). *Ctenopteris rigescens* (Bory ex Willd.) J. Sm.: 184 (1875). *Xiphopteris rigescens* (Bory ex Willd.) Alston: 26 (1956). Type: Réunion, *Bory de St. Vincent s.n.*, in Herb. Willdenow no. 19668 (B, holo.; FI, P, iso.).

Grammitis flabelliformis sensu Morton: 57 (1967). *Xiphopteris flabelliformis* sensu Schelpe: 217 (1967).

Pichi-Sermolli (1983) has clearly shown that, in terms of Art. 8 of the Code of Botanical Nomenclature, Morton's application of the name *Grammitis flabelliformis* (Poir.) Morton (loc. cit.) is unacceptable, and that the plants from Réunion belong to *Polypodium rigescens*, described by Willdenow in 1810, while Poiret's *Polypodium flabelliforme* applies to the central American taxon.

In accordance with current generic concepts in Grammitidaceae (Morton 1967; Proctor 1985; Stolze 1981), the recognition of *Xiphopteris* at generic level is not upheld, particularly in view of the poor value of degree of lamina dissection as a distinguishing criterion.

10. **Asplenium buettneri** *Hieron. ex Brause* in Wissenschaftliche Ergebnisse der Deutschen Zentral-

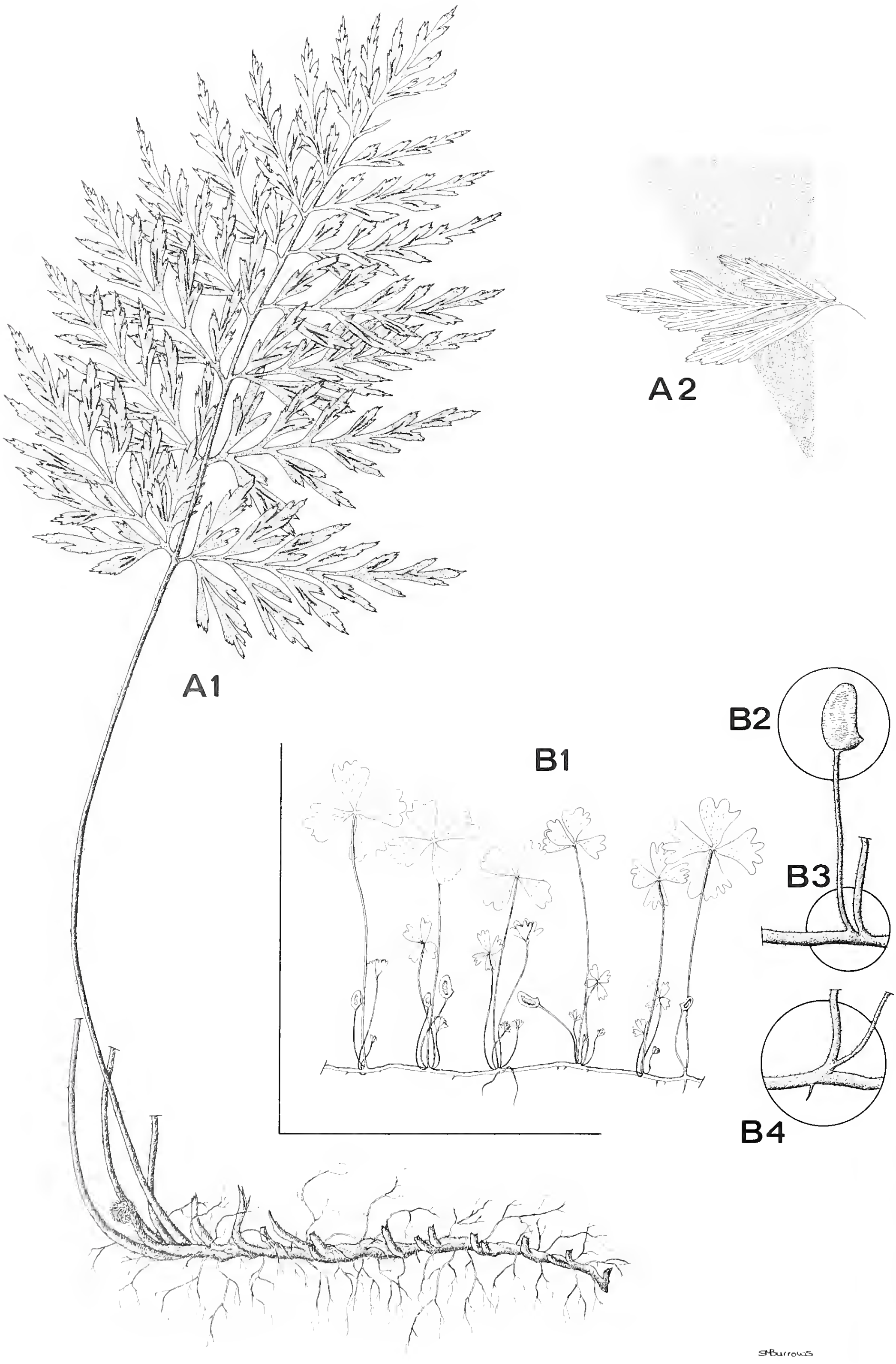

FIGURE 7.—*Asplenium sebungweense*, *Burrows 3026*: A1, frond and rhizome, × 0,6; A2, pinnule, × 1. *Marsilea farinosa* subsp. *arrecta*, *Burrows 3597*: B1, plant, × 0,6; B2, sporocarp, × 2; B3, B4, points of pedicel attachment, × 2.

Afrika-Expedition 1907–1908 2: 23, t.2, fig. 2 (1910). Type: Togo, Misahöhe, *Baumann 42* (B, lecto.; P).

Asplenium parablastophorum Braithewaite: 5 (1972). Type: Zimbabwe, Chimanimani Mts, *Mitchell 391* (BOL, holo.; SRGH, iso.!).

Icones: Tardieu-Blot: pl. XXXIII (1964); Jacobsen: fig. 270 (1983).

In the course of examining material of *Asplenium* from south and central Africa, it became obvious that *A. parablastophorum* Braithwaite from south-eastern Zimbabwe was identical to *A. buettneri* Hieron. from neighbouring Mozambique and tropical Africa, and accordingly the former is hereby sunk into *A. buettneri*.

Distribution: Ghana, Togo, Nigeria, Gabon, Cameroon, Zaïre, Tanzania, Zambia, Malawi, Mozambique and Zimbabwe.

11. **Asplenium sebungweense** *J.E. Burrows*, sp. nov.

Rhizoma repens, ± 5 mm diametro, frondibus 4–10 mm distantibus, interdum aspectu caespitosis. *Squamae rhizomae* 2,5–4 mm longae, atrobrunneae lineari-lanceolatae clathratae subintegrae; apex arista longa. *Stipes* laminam aequans vel eo longiore, ad 260 mm longus, castaneus vel fere ater, squamis atrobrunneis clathratis lineari-lanceolatis ad 2 mm longis modice obtectus, glabrescens. *Lamina* 150–250 × 100–140 mm, ovati-triangularis, bipinnata vel profunde tripinnatifida, pinnae basales longissimae. *Pinnae* ovatae vel triangulares. *Pinnulae* obcuneatae vel oblanceolatae, 4–14 mm latae, pinnulae proximales profunde pinnatifidae; margines distales profunde irregulariterque serrati et incisi, atrovirides, pagina supera glabra, pagina infera pallidior et glabra distali aliquot squamis nigris capillaceis ad 1 mm longis basim pinnularum proximis et secus rhachides secondarias; nervatura flabellata, prominens in superficiebus ambabus frondis. *Rachis* proximali ater, distali viridescens, squamis et pilis dispersis nigrescentibus obtectus. *Sori* numerosi, lineares, secus venas positas; indusium lineare, integrum, 3–9 × 0,2 mm.

TYPE.—Zimbabwe, tributary of Busi River, 12 km NE of Lusulu, Grid Ref. NL. 976095, *Craig, Mahlangu & Burrows 8* (PRE, holo.; Sengwa Herb., iso.).

Rhizome creeping, ± 5 mm in diameter, with fronds spaced 4–10 mm apart, sometimes appearing tufted. *Rhizome scales* 2,5–4 mm long, dark brown, linear-lanceolate, clathrate, subentire, with a long hair-tip. Stipe up to 260 mm long, as long or longer than the lamina, castaneous to almost black, lightly set with dark brown, clathrate, linear-lanceolate scales up to 2 mm long, glabrescent. *Lamina* 150–250 × 100–140 mm, ovate-triangular in outline, 2-pinnate to deeply 3-pinnatifid, with the basal pair of pinnae longer than those above. *Pinnae* ovate to triangular. *Pinnules* obcuneate to oblanceolate, 4–14 mm broad, becoming deeply pinnatifid proximally, apical margins deeply and irregularly serrate and incised, dark green, glabrous above, paler below and glabrous distally with scattered black, hair-like scales up to 1 mm long near the pinnule bases and along the secondary rachises, venation flabellate, prominent on both surfaces. *Rachis* black proximally, becoming matt-green distally, set with scattered, blackish scales and hairs. *Sori* numerous, linear, set along the veins; indusium linear, entire, 3–9 × 0,2 mm (Figure 7A).

A. sebungweense is closely allied to *A. aethiopicum* but is distinguished from the latter by the ovate-triangular frond, the relatively longer stipe and the thinner and more widely creeping rhizome. It occurs at altitudes of between 850 and 1 120 m, in hot and dry, deciduous woodland where it finds a degree of protection in deep ravines in the sandstone mantle that covers much of north-western Zimbabwe (Figure 4). *A. aethiopicum* is not found in this area and the two species are not known to overlap. *A. sebungweense* is remarkably constant morphologically compared to the highly variable *A. aethiopicum*.

ZIMBABWE.—1828 (Kamativi): Gokwe District, Charama Plateau, near Sai turn-off (–AB), *Burrows 3026* (Herb. Burrows); Sengwa Wildlife Research Institute, Kove River Gorge (–AA), *Burrows 2604* (Herb. Burrows).

ZAMBIA.—1324: North West Province, Kabompo Gorge, *Leach & Williamson 13469* (PRE).

12. **Asplenium uhligii** *Hieron.* in Botanische Jahrbücher 46: 374 (1912). Type: Tanzania, Kilimanjaro, *Uhlig 116* (B, holo.; P, iso.).

Icon: Tardieu-Blot: pl. XXVII, fig. 4 (1964).

A. uhligii is a high altitude fern occurring in deeply shaded recesses among boulders, growing in mats of *Hymenophyllum tunbridgense* (L.) Sm. together with *Grammitis rigescens* (Bory ex Willd.) J.E. Burrows. Although smaller than the typical form from central Africa, the thin, creeping rhizome and the short, ovate, shiny brown rhizome scales which lack any central cell wall thickening, are consistent and distinguish it from the superficially similar *A. aethiopicum* (Burm. f.) Becherer and *A. linckii* Kuhn.

MALAWI.—1535: Mount Mulanje, Sapitwa, 2 600 m, *Burrows 3758* (Herb. Burrows); *Wild 6200* (BOL, SRGH!).

ZIMBABWE.—1832: Nyanga District, Mount Inyangani, 2 560 m, *Burrows 2086* (Herb. Burrows).

Distribution: Togo, Nigeria, Cameroon, Zaïre, Uganda, Kenya and Tanzania.

13. **Thelypteris oppositiformis** *(C. Chr.) Ching* in Bulletin of the Fan Memorial Institute of Biology. Botany 10: 253 (1941). Type: Madagascar, *Perrier 7582* (P, holo.).

Dryopteris oppositiformis C. Chr. in Bonap.: 173 (1925).

Amauropelta oppositiformis (C. Chr.) Holtt.: 135 (1974).

Dryopteris tsaratananensis C. Chr.: 45 (1932). *Thelypteris tsaratananensis* (C. Chr.) Ching: 255 (1941). Type: Madagascar, Mt Tsaratanana, *Perrier 16455* (P, holo.).

Thelypteris strigosa sensu Schelpe: 193 (1970).

TRANSVAAL.—2530 (Lydenburg): Die Berg, between Roossenekal and Lydenburg (–AA), 2 200 mm, *Burrows 3709* (PRE, Herb. Burrows).

Distribution: Zimbabwe, Malawi, Tanzania, Uganda, Kenya, Ethiopia, Sudan, Cameroon, Nigeria.

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The genera *Polygonum* and *Bilderdykia* (Polygonaceae) in southern Africa: morphology and taxonomic value of the ocrea and fruit

G. GERMISHUIZEN*, P.J. ROBBERTSE** and P.D.F. KOK**

Keywords: *Bilderdykia*, fruits, key, morphology, ocrea, *Polygonum*, taxonomy

ABSTRACT

The external morphology of the fruit and the ocrea of 16 taxa of *Polygonum* and *Bilderdykia* in southern Africa was studied. Fruits are either lenticular or trigonous. Six types of fruit surfaces were distinguished. Five types of ocreae were found, characterized by: a green undulating limb; a silvery hyaline sheath; a brown tubular sheath without terminal hairs; a terminal fringe of short cilia or setae; and a bristly hairy sheath fringed with long rigid setae.

UITTREKSEL

Die uitwendige morfologie van die vrug en die okrea van 16 taksons van die genusse *Polygonum* en *Bilderdykia* in suidelike Afrika is ondersoek. Vrugte is òf lensvormig òf driehoekvormig. Vrugoppervlakke word in ses groepe verdeel. Vyf verskillende okrea-tipes word aangetref, gekenmerk deur: 'n groen golwende aanhangsel; 'n silweragtige hialiene skede; 'n bruin buisvormige skede sonder hare aan die punt; 'n fraiing kort siliums of borselhare; en 'n borselharige skede met 'n fraiing lang, stywe borselhare.

INTRODUCTION

The aim of this study was to examine the morphology of the ocrea and fruit of 16 of the southern African species of the genera *Polygonum* and *Bilderdykia*, and to determine their taxonomic importance.

MATERIALS AND METHODS

The herbarium voucher specimens mentioned in the captions of the figures are all kept at the National Herbarium (PRE), Botanical Research Institute, Pretoria.

Fruits were coated with gold-palladium and studied and photographed with the aid of a scanning electron microscope (Hitashi-Akashi Model MSM-4). The negatives are stored in the Botanical Research Institute, Pretoria.

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RESULTS

Organography of the fruits

In *Polygonum* and *Bilderdykia* the ovary is superior, sessile, 1-locular, with a solitary basal, sessile or stalked ovule. The fruit is a nut enclosed by the persistent perianth (Dyer 1975). During dispersal the seed remains enclosed in the entire fruit wall (Harder & Firbas 1965).

Based on the shape of the fruit, two types are recognized (Table 1): 1, trigonous or 3-angled fruits (Figure 1A) and 2, lenticular fruits (Figure 1B). In both types the surfaces are either concave (Figure 1A) or convex (Figure 1C). Trigonous fruits and lenticular fruits with convex surfaces

TABLE 1.—Fruit shape, surface type and ocrea type found in species of *Polygonum* and *Bilderdykia*

	Fruit shape	Fruit surface	Ocrea
P. aviculare	trigonous	with protuberances	silvery hyaline
plebeium		smooth, shiny	silvery hyaline
kitaibelianum		smooth, shiny	silvery hyaline
maritimum		criss-cross	silvery hyaline
meisnerianum		criss-cross	without terminal hairs
B. convolvulus		with protuberances	without terminal hairs
P. salicifolium		smooth, shiny	short rigid setae
P. lapathifolium	lenticular, concave	smooth, shiny	without terminal hairs
senegalense		ridged	without terminal hairs
P. nepalense	lenticular, convex	areolate	without terminal hairs
hystriculum		ridged	short rigid setae
amphibium		warty	without terminal hairs
undulatum		smooth, shiny	silvery hyaline
hydropiper		ridged	short rigid setae
limbatum		smooth, shiny	spreading limb
pulchrum		smooth, shiny	bristly hairy

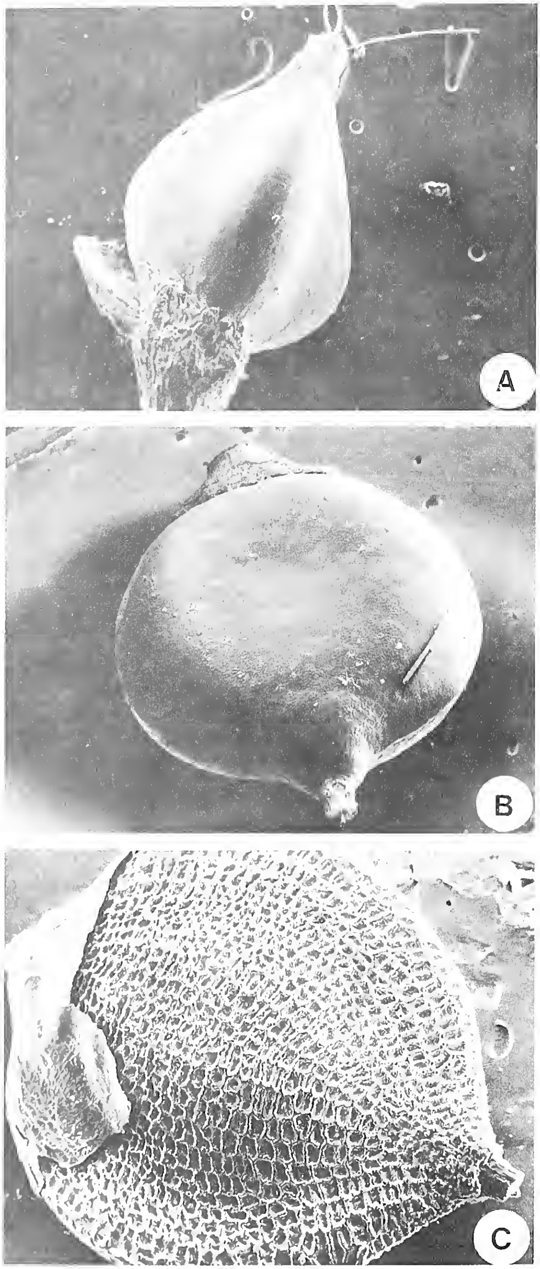

FIGURE 1.—Electron micrographs of *Polygonum* spp. A, trigonous fruit, *P. plebeium, Germishuizen 1386*, × 36; B, lenticular-concave fruit, *P. senegalense* subsp. *senegalense, Germishuizen 1169*, × 30; C, lenticular-convex fruit, *P. nepalense, Scheepers 1130*, × 54.

are common, whereas lenticular fruits with concave surfaces are found only in *Polygonum lapathifolium* and *P. senegalense* (Table 1).

The surface of the fruits varies considerably and six different types of surfaces can be distinguished (Table 1):

1, with protuberances of varying size (Figure 2A). The fruits have a dull matted appearance;

2, smooth and shiny (Figure 2B);

3, with criss-cross pattern (Figure 2C);

4, ridged (Figure 2D);

5, areolate (Figure 2E), found only in *P. nepalense*;

6, warty (Figure 2F), found only in *P. amphibium*.

Organography of the ocrea

The ocrea (plural: ocreae; sometimes spelled ochreae), is a tubular sheath formed when the stipules are united into a hood, which covers the stem apex at first; later it is ruptured and remains as a membranous tube surrounding the stem at the nodes (Harder & Firbas 1965).

Ocreae of the southern African species of the genera *Polygonum* and *Bilderdykia* can be divided into five different types (Table 1):

1, a tubular membranous sheath ending terminally in a spreading or recurved, green, leaf-like undulating limb with a strigose margin (Figure 3A). This type occurs only in *P. limbatum*.

2, a silvery hyaline sheath, conspicuously veined, reddish at the base or red all over, lacerating easily (Figure 3B). This type is found in five species.

3, a brown membranous tubular sheath, conspicuously veined without or rarely with short terminal hairs (Figure 3C). This type occurs in six species.

4, a tubular membranous sheath fringed with short rigid cilia or setae (Figure 3D). This type occurs in three species.

5, a brown tubular sheath, bristly hairy and fringed with numerous long rigid setae and tearing readily on one side (Figure 3E). This type is found only in *Polygonum pulchrum*. Ocreae can be smooth and hairless (Figure 4A) or pubescent with multicellular trichomes (Figure 4B).

DISCUSSION AND CONCLUSION

From Table 1 a key has been compiled using only fruit shape, fruit surfaces and ocreae found in species of *Polygonum* and *Bilderdykia*.

1a Nut trigonous:
- 2a Ocrea silvery hyaline:
  - 3a Nut smooth, shiny .... *P. plebeium*, *P. kitaibelianum*
  - 3b Nut with protuberances .... *P. aviculare*
  - 3c Nut with criss-cross pattern .... *P. maritimum*
- 2b Ocrea not silvery hyaline:
  - 4a Ocrea with short rigid setae .... *P. salicifolium*
  - 4b Ocrea without terminal hairs:
    - 5a Nut surface with protuberances .... *B. convolvulus*
    - 5b Nut surface with criss-cross pattern .... *P. meisnerianum*

1b Nut lenticular:
- 6a Nut with concave surface:
  - 7a Nut surface smooth, shiny .... *P. lapathifolium*
  - 7b Nut surface ridged .... *P. senegalense*
- 6b Nut with convex surface:
  - 8a Ocrea with green spreading limb .... *P. limbatum*
  - 8b Ocrea without spreading limb:
    - 9a Nut surface smooth, shiny:
      - 10a Ocrea silvery hyaline .... *P. undulatum*
      - 10b Ocrea bristly hairy .... *P. pulchrum*
    - 9b Nut surface ridged, areolate or warty:
      - 11a Ocrea without terminal setae:
        - 12a Nut surface areolate .... *P. nepalense*
        - 12b Nut surface warty .... *P. amphibium*
      - 11b Ocrea with short rigid terminal setae; nut surface ridged .... *P. hystriculum*, *P. hydropiper*

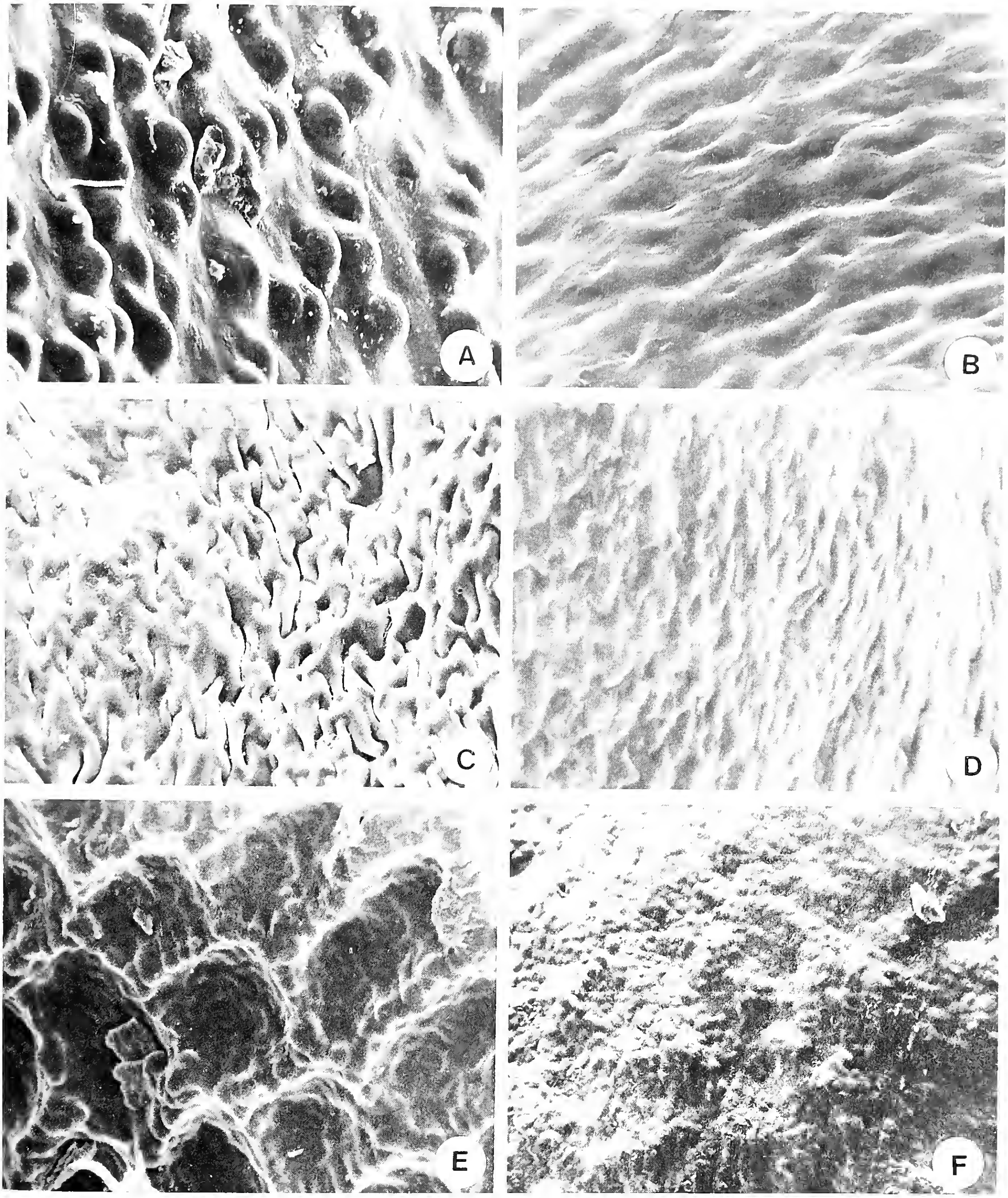

FIGURE 2. —Electron micrographs of fruit surfaces of *Polygonum* and *Bilderdykia* species. A, surface with protuberances, *B. convolvulus, Jacobsz 196*, × 860; B, surface smooth, *P. salicifolium, Germishuizen 1291*, × 4000; C, surface with criss-cross pattern, *P. maritimum, Taylor 4897*, × 850; D, surface ridged, *P. hystriculum, Germishuizen 1357*, × 520; E, surface areolate, *P. nepalense, Scheepers 1130*, × 650; F, surface warty, *P. amphibium, Nelson 226*, × 220.

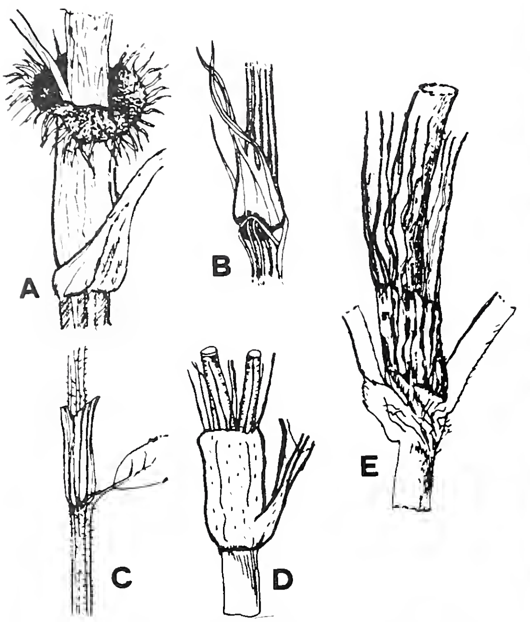

FIGURE 3.—Schematic representation of ocrea types found in some taxa of the genus *Polygonum*. A, *P. limbatum*, × 4; B, *P. kitaibelianum*, × 2; C, *P. meisnerianum*, × 2; D, *P. hydropiper*, × 4; E, *P. pulchrum*, × 4.

In their treatments of the family Polygonaceae, C.H. Wright in *Flora capensis* (1912) and R.A. Graham in *Flora of tropical east Africa* (1958) make some use of the fruit shape and ocrea type in their species keys, and they make reference to them in their descriptions.

In the *Flora of southern Africa* (Vol. 9,1 in prep.) fruit shape, fruit surface and ocrea type play a major role in the keys. In this paper it is the first time that these features have been illustrated. In the genera *Polygonum* and *Bilderdykia* the fruit and the ocrea are the two most important organs for distinguishing between the taxa.

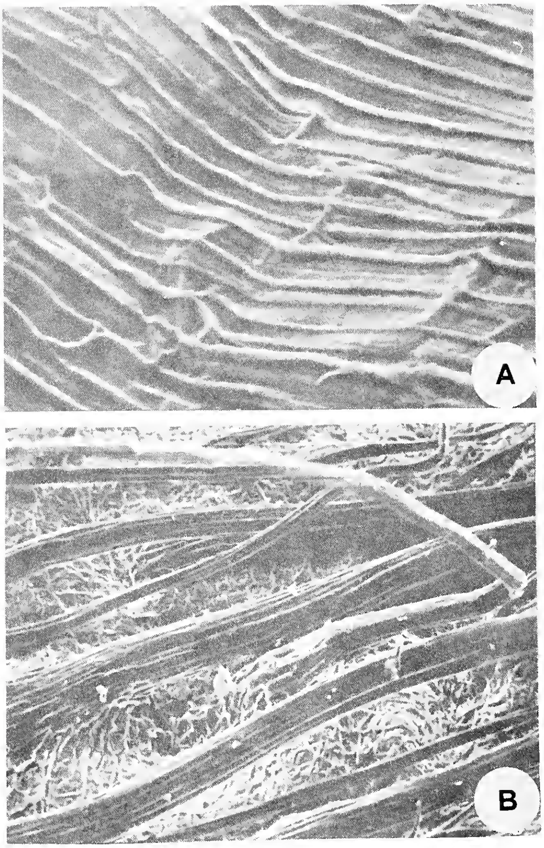

FIGURE 4.—Electron micrographs of a portion of the ocrea surface of certain members of the genus *Polygonum*. A, *P. aviculare*, *Germishuizen 1265*, × 360; B, *P. pulchrum*, *Germishuizen 1240*, × 102; C, *P. limbatum*, *Germishuizen 1361*, × 204.

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A re-examination of the genus *Amphibolia* (Mesembryanthemaceae)

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Keywords: *Amphibolia*, lectotypification, Mesembryanthemaceae

ABSTRACT

The holotypes of all five species placed in the genus *Amphibolia* L. Bol. ex Toelken & Jessop have been examined. Only two of them agree with the generic diagnosis, but they are not congeneric. The type species chosen by Herre is shown to be in serious conflict with the protologue and a new lectotype (*A. maritima* L. Bol. ex Toelken & Jessop) is therefore designated. The other four species are excluded from *Amphibolia*.

UITTREKSEL

Die holotipes van al vyf spesies wat in die genus *Amphibolia* L. Bol. ex Toelken & Jessop geplaas word, is ondersoek. Slegs twee van hulle stem ooreen met die diagnose van die genus, maar hulle is nie kongeneries nie. Daar word aangetoon dat die tipespesie wat deur Herre gekies is, ernstig met die protoloog in stryd is, en daarom word 'n nuwe lektotipe (*A. maritima* L. Bol. ex Toelken & Jessop) aangewys. Die ander vier spesies word uit *Amphibolia* uitgesluit.

INTRODUCTION

In the course of a comprehensive study of the subtribe Ruschiinae (M. Dehn) and the preparation of a survey of the genera of the Aizoaceae (H.E.K. Hartmann), the genus *Amphibolia* L. Bol. ex Herre (Toelken & Jessop 1976) has been re-examined. The results and taxonomic consequences are presented.

Amphibolia was first described by Bolus (1965). It was lectotypified and thus validated by Herre (1971). Toelken & Jessop (1976) reviewed the nomenclature and supplied correct names for all five species included in the genus at that time.

The history of the genus started earlier, though, when Bolus (1962) noticed that the two species she had described in the genus *Stoeberia* Schwant. (*S. hallii, S. littlewoodii*) did not conform with the generic characters of that genus, 'a new genus is therefore required for them ...' (l.c. p. 14). The diagnosis of that new genus, namely *Amphibolia* (Bolus 1965), gives three characters: perennial, fruits with winged valves (like in *Lampranthus*) and closing bodies (like in *Ruschia* and *Stoeberia*). In addition Bolus stated that the capsules differ from those of *Stoeberia* insofar as they open spontaneously and do not close again. No further features were mentioned, but Herre (1971) provided a short description.

RESULTS

Since the diagnosis of *Amphibolia* stresses fruit characters, the present re-examination also concentrates on capsules. The holotypes of all five species placed in the genus were examined. Three different combinations of the relevant character expressions could be distinguished (Table 1). *A. maritima* and *A. littlewoodii* possess valve wings and closing bodies (CB), as well as closing rodlets (CR) at the distal end of the covering membranes (Figure 1B). The remaining three species lack closing bodies, but two of them (*A. hallii* and *A. gydouwensis*) possess closing rodlets (CR in Figure 1D). *A. stayneri* shows no closing device at all.

It seems that in the last three species mentioned the prominent free end of the placenta (PL in Figure 1D) has been understood to represent a closing body (compare data from descriptions in Table 1). This interpretation, however, has to be rejected. The relevant placental structure is not in direct contact with the tangential endocarp, as would be necessary for an endocarpal closing body (Hartmann & Liede 1986). Furthermore, funicles occur up to the tip of the placenta (F in Figure 2), precluding, for lack of space, the formation of a placental tubercle (as described for *Pleiospilos* subgenus *Pleiospilos* by Hartmann & Liede 1986).

Remarkable, even though not mentioned in all descriptions, is the existence of closing rodlets in four of the five species (Table 1, CR in Figure 1B, D).

Examination of additional characters shows distinct differences between the two species with closing bodies. Capsules of *A. maritima* break off easily and regularly after ripening, leaving the persistent peduncle on the plant, thus forming a spine; capsules and peduncles are light-coloured, almost white, like all stems and branches of the plant; the margins of the valves are only moderately raised and, as a consequence, the valves open so completely that the tips touch the base of the fruit. Other distinguishing features of *A. maritima* are short, inflated, roundish leaves, small flowers and petals barely reaching the tips of the calyx lobes. In contrast, capsules of *A. littlewoodii* remain on the peduncles and they are dark reddish brown from numerous tanniniferous idioblasts, like all stems and branches. The margins of the valves are raised to high rims preventing the valves from opening further than 180°. Other characteristic features of *A. littlewoodii* are long, slender leaves and larger flowers with the petals exceeding the tips of the calyx lobes.

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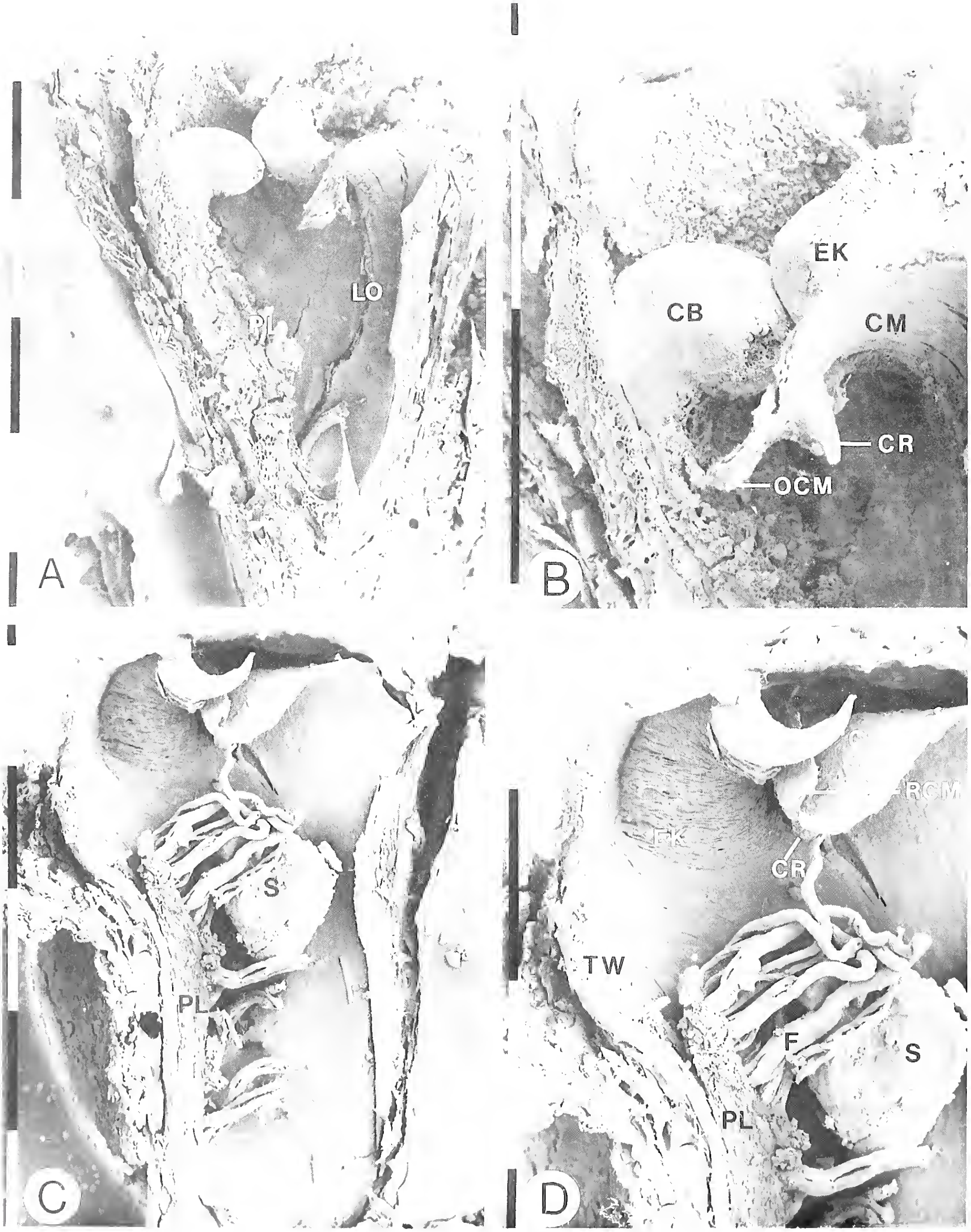

FIGURE 1.—Longitudinal sections of capsules. A, B, *Amphibolia maritima* (*Hall 2885*, BOL): locule (LO) blocked apically by closing body (CB) protruding from inner wall (W) of capsule; placenta (PL) torn to its base; in dry state (seen here) closing body touches expanding keel (EK) but not covering membrane (CM); closing rodlet (CR) and adjacent bend of outer part of covering membrane (OCM) pulled out from between valve proper and expanding keel at first opening of capsule. C, D, *Amphibolia hallii* (*Hall 1741*, BOL): placenta (PL) separates apically from endocarp and bears funicles (F) to its very tip; thickening of outer fruit wall (TW) above placenta (similar to condition in *Lampranthus*-type fruit; Hartmann 1988), distal end of covering membrane (CM) bent against expanding keel (EK), resembling position in unopened fruit. RCM, reflexed part of covering membrane; S, seed. Scale in mm.

TABLE 1.—Comparison of fruit characters of *Amphibolia, Ruschia* and *Lampranthus* as observed in the holotypes and as given in original description

Taxon (holotype)	Valve wings holo.	Valve wings descr.	Closing bodies holo.	Closing bodies descr.	Closing rodlets holo.	Closing rodlets descr.
A. maritima, Hall 2885 !	+	+	+	+	+	−
A. littlewoodii, Littlewood KG 522/59 !	+	+	+	+	+	+
A. hallii, Hall 1741 !	+	+	−	+	+	+
A. gydouwensis, Leipoldt 4801 !	+	+	−	−	+	+
A. stayneri, Stayner KG 258/65 !	+	+	−	+	−	−
Ruschia	(+),−		+		+	
Lampranthus	+		−		(+),−	

( ) = Rare expression of characters.

CONCLUSIONS

In the light of recent findings in fruit typology (Hartmann 1988) and in generic delimitations in the wider relationship of the Ruschiinae (Dehn 1989, and in prep.), the groups described above can be allied to different fruit types and, consequently, to different genus groups.

Dehn (1989, and in prep.) has been able to show that valve wings may occur within the *Ruschia*-type of fruit. The possession of these structures can therefore not be used to exclude taxa from that group. Essential character expressions are the possession of small endocarpal closing bodies and of closing rodlets at the covering membranes.

A. maritima and *A. littlewoodii* agree with these requirements, but they differ in other characters not considered by Bolus (1965) in the delimitation of *Amphibolia*. Seeing that fruit characters are presently considered to be of great taxonomic importance in Mesembryanthema (e.g. Hartmann 1983; Dehn 1989; Ihlenfeldt & Bittrich 1985), the two species have to be understood as belonging to two different genera within the group characterized by the *Ruschia*-type of fruit. Whereas *A. maritima* shows several similarities to the genus *Eberlanzia* (valve wings, small closing body, widely opening valves, inflated short leaves, white stems, pedicels becoming spines; all data after Stüber unpublished), *A. littlewoodii* can be placed within the close relationship of the genus *Ruschia* (small closing body, narrow valve wings opening into an upright position, long slender leaves, dark reddish stems; Dehn in prep.).

Of the remaining three species, *A. hallii* and *A. gydouwensis* lack closing bodies but possess valve wings and closing rodlets (Table 1). This combination places them closest to the *Lampranthus*-type fruit (Hartmann 1988) which is characterized by valve wings and closing ledges in the absence of closing bodies; characteristic also is a thickened tissue within the outer wall above the zone where the placenta ends (similar to TW in Figure 1D). Preliminary investigations in the genus *Lampranthus* indicate that the taxon is probably heterogeneous and will have to be divided up, *A. hallii* and *A. gydouwensis* agreeing with a certain part of the material.

Superficially, *A. stayneri* may be placed in the vicinity of the *Lampranthus*-type fruit as well, but the complete absence of any closing device and the formation of rather fragile capsules indicates a closer relationship to the *Drosanthemum*-type of fruit (Hartmann 1988). Within this group, the nearest relative seems to be the genus *Mestoklema* (this hypothesis is supported by the formation of a remarkable storage root in *A. stayneri*, a feature common in *Mestoklema*, but further characters will have to be examined).

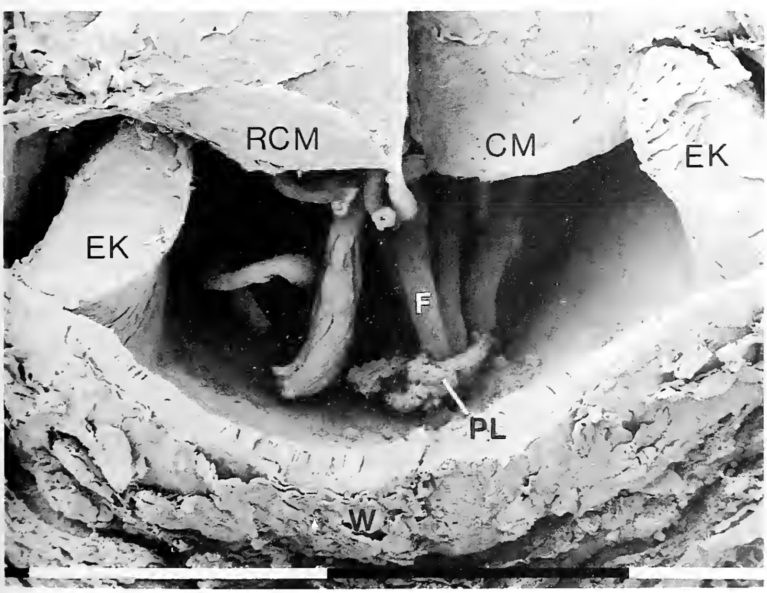

FIGURE 2.—*Amphibolia hallii*: distal opening of locule of capsule shown in Figure 1C,D seen from above after removal of valve, showing end of placenta (PL) which can be mistaken for a closing body. CM, covering membrane; EK, expanding keel; F, funicle; PL, placenta; RCM, reflexed part of covering membrane; W, wall. Scale in mm.

The results show that only two species, *A. maritima* and *A. littlewoodii*, conform with the generic diagnosis. This implies that the lectotype species (*A. hallii*) selected by Herre (1971) is in serious conflict with the protologue (Greuter *et al.* 1988, art. 8.2,b) and has to be replaced by one of the two species named above. *A. maritima* is selected as the new lectotype species because its valve wings are particularly broad, thus conforming best with the genus *Stoeberia* considered to be closest to *Amphibolia* by Bolus (1965) when she established the latter genus.

The taxonomy of the genus *Amphibolia*, as given below, reflects the present state of knowledge.

TAXONOMY

Amphibolia *L. Bol. ex Herre*, The genera of Mesembryanthemaceae: 70 (1971); L. Bol.: 169 (1965); Toelken, H.R. & Jessop, J.P.: 64 (1976). Lectotype species (here designated): *A. maritima* L. Bol. ex Toelken & Jessop. This lectotypification supercedes the lectotypification of Herre (1971), *A. hallii*, because the character expressions of that species are in serious conflict with the protologue.

A. maritima *L. Bol. ex Toelken & Jessop* in Bothalia 12: 64 (1976); L. Bol.: 169 (1965). Lectotype species. Holotype: *Hall 2885* (BOL!). Nomenclatural synonym: *Ruschia maritima* Rowley: 62 (1978b).

Species excluded

1. Species close to the genus *Ruschia* Schwant.:

A. littlewoodii *(L. Bol.) L. Bol. ex Toelken & Jessop* in Bothalia 12: 64 (1976); L. Bol.: 170 (1965). Basionym: *Stoeberia littlewoodii* L. Bol.: 162 (1960). Holotype: *Littlewood KG 522/59* (BOL!). Nomenclatural synonym: *Ruschia mutata* Rowley: 7 (1978a) non *Ruschia littlewoodii* L. Bol.

2. Species close to the genus *Lampranthus* N.E. Br.:

A. hallii *(L. Bol.) L. Bol. ex Toelken & Jessop* in Bothalia 12: 64 (1976); L. Bol.: 161 (1960). Basionym: *Stoeberia hallii* L. Bol.: 161 (1960). Holotype: *Hall 1741* (BOL!). Nomenclatural synonym: *Ruschia amphibolia* Rowley: 7 (1978a) non *Ruschia hallii* L. Bol.

A. gydouwensis *(L. Bol.) L. Bol. ex Toelken & Jessop*: 64 (1976), L. Bol.: 306 (1967). Basionym: *Lampranthus gydouwensis* L. Bol.: 13 (1963). Holotype: *Leipoldt 4801* (BOL!). Nomenclatural synonym: *Ruschia gydouwensis* Rowley: 7 (1978a).

3. Species perhaps close to *Mestoklema* N.E. Br.:

A. stayneri *L. Bol. ex Toelken & Jessop* in Bothalia 12: 64 (1976); L. Bol.: 126 (1966). Holotype: *Stayner KG 258/65* (BOL!). Nomenclatural synonym: *Ruschia dissimilis* Rowley: 62 (1978b) non *Ruschia stayneri* L. Bol.

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A contribution to the pteridophyte flora of Transkei

C.T. JOHNSON* and A. HUTCHINGS**

Keywords: analysis, checklist, ecology, Pteridophyta, Transkei

ABSTRACT

An analysis of the data is presented in three tables and a comparison is made with that of adjacent areas. *Lygodium kerstenii**** and *Dryopteris dracomontana* are recorded from Transkei for the first time. The 129 species, with their subspecies and varieties (137 taxa in all), in the 51 genera of Transkei are listed. Coded distribution ranges are given for each taxon.

UITTREKSEL

'n Analiese van die data word in drie tabelle gegee en 'n vergelyking word getref met naasliggende areas. *Lygodium kerstenii**** en *Dryopteris dracomontana* word vir die eerste keer vir Transkei aangeteken. Die 129 spesies, met hulle subspesies en variëteite (137 taksons altesaam), in die 51 genusse van Transkei word gelys. Vir elke takson word 'n gekodeerde verspreiding gegee.

INTRODUCTION

Prior to this publication, information on the pteridophytes of Transkei was limited (Sim 1915; Roux 1982; Jacobsen 1983; Anthony & Schelpe 1985; Schelpe & Anthony 1986). The aim of this research project was to establish a herbarium of the pteridophyte flora of Transkei, to determine the distribution of the taxa within Transkei, to compile a floristic analysis of the pteridophytes and to prepare a checklist of them.

METHODS

The data for this paper was collected over a period of six years (1981–1986) and presents a summary of an unpublished report by Johnson & Hutchings (1986). During the course of this survey extensive collections were undertaken and the herbarium specimens are housed at KEI and BOL. The following herbaria were visited in order to record additional collections: BOL, J, NBG, NU, SAM, GRA, PRE, UPR.

Transkei comprises a number of quarter degree grids. For each taxon the grid references are given in which it was collected in Transkei (Figure 1). The arrangement and spelling of the families and genera are according to Schelpe & Anthony (1986). Southern Africa is delimited as in the *Flora of southern Africa*.

RESULTS AND DISCUSSION

From the floristic analysis (Tables 1 & 2) it is apparent that Transkei is relatively rich in pteridophytes. Twenty three pteridophyte families are present with 51 genera and 129 species. Only five of the 28 families listed for southern Africa (Anthony & Schelpe 1985) are not found in Transkei. A comparison of the 23 families (Table 1) common to Transkei and southern Africa reveals a difference of 16 genera and 114 species.

The four largest pteridophyte families in Transkei are Dryopteridaceae with seven genera, Adiantaceae and Polypodiaceae with six genera and Schizaeaceae with four genera. In addition Dennstaedtiaceae and Davalliaceae have three genera, Aspleniaceae, Athyriaceae, Blechnaceae, Thelypteridaceae and Osmundaceae are represented by two genera each, while the remaining 12 families have one genus each.

The two largest genera are *Asplenium* and *Cheilanthes* with 22 and 10 species respectively. *Lycopodium* has seven species followed by *Thelypteris* with six species. *Blech-*

TABLE 1.—Comparison of number of taxa per family for Transkei and southern Africa. Comparative data for southern Africa from Schelpe & Anthony 1986

	Transkei		Southern Africa	
	Genera	Spp.	Genera	Spp. & va s
Psilotaceae	1	1	1	1
Lycopodiaceae	1	7	1	10
Selaginellaceae	1	4	1	7
Equisetaceae	1	1	1	1
Ophioglossaceae	1	3	1	7
Marattiaceae	1	1	1	1
Osmundaceae	2	2	2	2
Gleicheniaceae	1	2	2	3
Schizaeaceae	4	5	4	7
Marsileaceae	1	2	1	16
Cyatheaceae	1	2	1	2
Hymenophyllaceae	1	3	2	11
Dennstaedtiaceae	3	4	5	7
Vittariaceae	1	1	1	1
Adiantaceae	6	21	9	57
Polypodiaceae	6	10	6	15
Davalliaceae	2	3	4	5
Aspleniaceae	2	23	2	31
Thelypteridaceae	2	7	3	12
Athyriaceae	2	2	5	6
Lomariopsidaceae	1	5	2	9
Dryopteridaceae	7	14	10	22
Blechnaceae	2	6	2	10
Total	51	129	67	243

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*** The identity of the material is still being investigated./Die identiteit van die materiaal word nog ondersoek.

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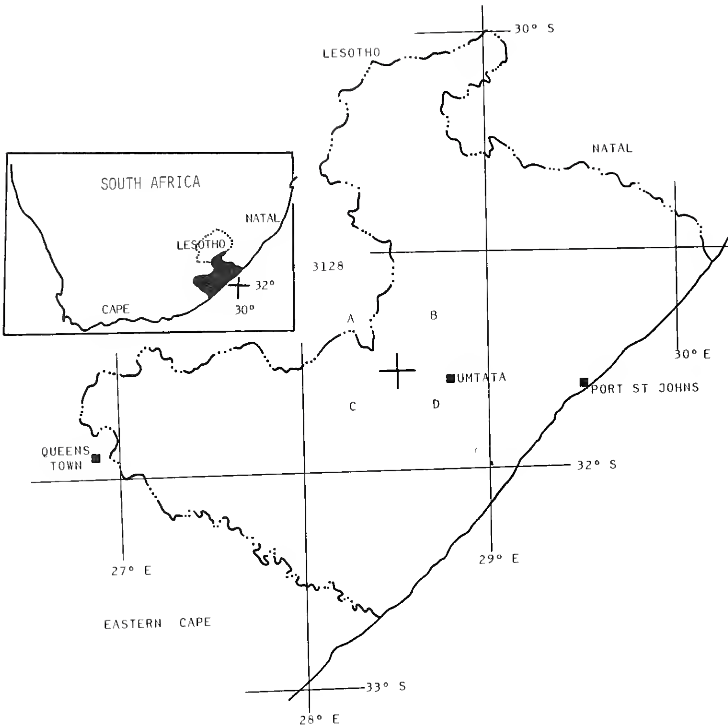

FIGURE 1.—Map showing geographical location and grid references of the study area.

num, Polystichum, Pteris and *Elaphoglossum* each have five species. *Selaginella* and *Dryopteris* have four species each; *Ophioglossum, Trichomanes, Adiantum* and *Microsorium* have three species each; *Gleichenia, Schizaea, Marsilea, Cyathea, Blotiella, Polypodium* and *Pleopeltis* have two species each and there are 30 genera with one species each.

During this survey *Lygodium kerstenii** and *Dryopteris dracomontana*, previously not recorded for Transkei, were collected. The gap in the distribution range of *Dryopteris dracomontana*, from Natal to the Cape Province (Schelpe & Anthony 1986), was closed with the discovery of this species. The distribution range of *Elaphoglossum conforme*, which was previously assumed to be confined to the southern and south-western Cape, has now been extended to the Transkei. *Mohria caffrorum* and *Equisetum ramosissimum* are species with wide distribution and were recorded in 60% of the degree grids.

It must be emphasized that *Adiantum raddianum, Nephrolepis exaltata* and *Macrothelypteris torresiana* are introduced species (Jacobsen 1983) which are widely cultivated and have now become established in nature.

Comparing the statistical data (Table 2), one finds that the Transkei flora comprises 68,9% (51) and 51,6% (129) of the southern African genera or species respectively. The decrease in the number of taxa from Natal to the southern Cape must be attributed to the differences in the climatic conditions along this gradient.

Information about density and species distribution can be drawn from the distributional analysis (Table 3) and

TABLE 2.—Comparison of the pteridophyte floras of various regions. Comparative data from Schelpe & Anthony 1986

	Spp.	Genera	Families
Southern Africa	250	7	28
Natal	192	67	28
Transkei	129	51	23
Eastern Cape	111	42	23
Southern Cape	98	35	21

TABLE 3.—Distribution of taxa in grids

Degree square	Number of taxa in quarter degree square A	B	C	D	Degree square
3028	4	3	–	6	10
3029	17	8	8	12	36
3030	*	*	24	*	25
3127	1	4	4	30	31
3128	18	36	32	13	65
3129	10	33	12	75	95
3130	14	*	*	*	14
3227	–	–	*	*	0
3228	7	18	3	4	29
3229	3	*	*	*	3

* Quarter degree not in study area.

the floristic analysis (Figure 2). The first impression is that species density is at its highest in grid 31°S 29°E (95 taxa: 69,3% of total number in Transkei) and 31°S 28°E (65 taxa: 47,4%). Within these degree squares, the most concentrated collecting occurred around the towns of Port St Johns and Umtata. Closer examination shows that no record exists for grid 32°S 27°E. Since the collecting

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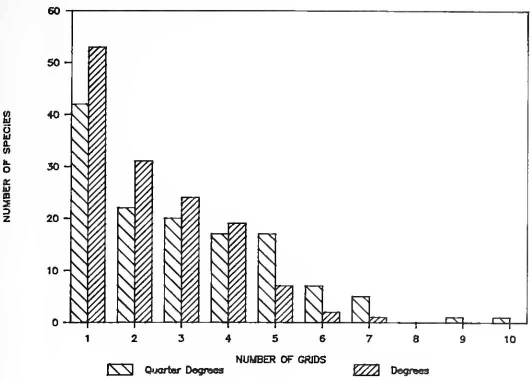

FIGURE 2.—Species density in the study area.

intensity for the entire area is very low (Gibbs Russell *et al.* 1984), it is impossible to state whether Pteridophyta are completely absent from these areas.

ECOLOGY

Pteridophytes are distributed across a wide range of habitats in Transkei, occurring from the coastal regions to the highest elevations of over 2 700 m. The greatest variety of species, habit and development is found in the forest, where they grow along streams, on the forest floors, on boulders, or on the stems of trees. Roux (1982) divided the pteridophyte flora of Transkei into forest and non-forest types.

High-level epiphytes are found growing high up on the stems and even branches of trees in humid forest. These include *Pyrrosia africana, Microsorium punctatum, Pleopeltis macrocarpa* and *Polypodium polypodioides* subsp. *ecklonii. Asplenium sandersonii, A. prionitis* and *Microgramma lycopodioides* are low-level epiphytes that are found growing low down on the stems of trees.

Lithophytes that occur in wet coastal forest with high humidity and deep shade are *Asplenium rutifolium* and *Microsorium punctatum*. True lithophytes are *Lycopodium gnidioides, L. verticillatum, Selaginella mittenii, Trichomanes pyxidiferum* var. *melanotrichum, Microgramma lycopodioides, Oleandra distenta, Asplenium gemmiferum, Rumohra adiantiformis* and *Vittaria isoetifolia*.

Occurring as ground cover in forests are *Selaginella kraussiana, Marattia fraxinea* var. *salicifolia, Pteris buchananii, P. catoptera* var. *horridula, Cheilanthes bergiana* and *Blechnum punctulatum* var. *krebsii. Microsorium scolopendrium* occurs on the landward side of dune forests.

Few ferns are found in open grassland and when they do it is always in association with rocky outcrops, stream banks, ditches and along forest margins. *Selaginella dregei, Pityrogramma calomelanos* var. *aureoflava*, and *Cyrtomium caryotideum* var. *micropterum* were collected from exposed rocky outcrops. In a similar habitat but slightly protected, *Selaginella caffrorum, Cheilanthes inaequalis* var. *buchananii, Elaphoglossum macropodium, Blechnum punctulatum* var. *punctulatum* and *Lycopodium gnidioides* occur.

Lycopodium clavatum, L. cernuum, L. carolinianum var. *carolinianum, Equisetum ramosissimum, Osmunda regalis, Todea barbara, Mohria caffrorum, Gleichenia polypodioides, Cyathea dregei, Hypolepis sparsisora, Pteridium aquilinum, Adiantum capillus-veneris, A. raddianum, Pteris vittata, Nephrolepis exaltata, Thelypteris confluens, T. totta, Blechnum capense* and *B. tabulare* are found growing on wet banks and forest margins. The only aquatic species are *Marsilea macrocarpa* and *M. capensis*.

Selaginella dregei, Schizaea pectinata, Cheilanthes involuta var. *involuta* and *Pellaea calomelanos* are found in fully exposed dry habitats.

CONSERVATION

Although the primary concern of this manuscript does not relate to the problems of conservation, it is necessary to sound a warning on the threat that exists to this element of Transkei's flora. Of the 60 species that are regarded as rare for southern Africa (Jacobsen 1983), *Asplenium simii, Elaphoglossum angustatum, E. hybridum, Lycopodium saururus, Microsorium ensiforme, Polystichum luctuosum, Psilotum nudum, Trichomanes reptans* and *Woodsia montevidensis* var. *burgessiana* were recorded in Transkei. With the discovery of *Lygodium kerstenii**, along the south-facing slope of Mt Sullivan in Port St Johns, the rare species count was increased to 10. This figure is probably still too low as Transkei is undercollected.

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to the Council of the University of Transkei for their financial assistance. The success of this research project was highly dependant on the co-operation received from the curators of BOL, J, NBG, NU, SAM, GRA, PRE, and UPR for allowing us access to their material. The authors are most grateful for the help we received from Mrs Nicola Anthony and Mr J.P. Roux with the determination of species. We acknowledge with gratitude the work of earlier collectors, without whom we could not have achieved our goal.

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* The identity of the material is still being investigated./Die identiteit van die materiaal word nog ondersoek.

CHECKLIST OF THE PTERIDOPHYTES OF TRANSKEI

(*information from Schelpe & Anthony 1986)

PSILOTALES

PSILOTACEAE
Psilotum *Swartz*
nudum *(L.) Beauv.*, 3129 BD, *Johnson 896* (KEI); 3129 DA, *Schelpe 350* (NU); 3228 CB, *Pocock 30134* (GRA)

LYCOPODIALES

LYCOPODIACEAE
Lycopodium *L.*
saururus *Lam.*, 3030 CC, *Johnson 2116* (KEI)
verticillatum *L. f.*, 3029 DA, *Getliffe 105* (NU); 3128 BC, *Hutchings & Johnson M2* (KEI); 3129 DA, *Johnson 138* (KEI); 3228 AD, *Pegler 821* (BOL)
dacrydioides *Bak.*, 3128 CA, *Cawe 709* (KEI); 3129 DA, *Mcloughlin s.n.* (BOL)
gnidioides *L. f.*, 3029 DA, *Roux 630* (NBG); 3030 CC, *Roux 651* (NBG); 3030 AA, *Strey 8646* (BOL); 3128 BC, *Hutchings & Johnson M3* (KEI); 3128 CA, *Cawe 709* (BOL); 3129 DA, *Mcloughlin s.n.*, *809* (BOL)
cernuum *L.*, 3029 DD, *Johnson 168* (KEI); 3030 CC, *Hilliard 1122* (NU); 3129 BC, *Ward 5794* (NU); 3129 BD, *Cawe s.n.* (KEI); 3129 DA, *Hutchings & Plumstead 2058* (KEI); 3130 AA, *Ward 205* (NU); 3129 BD, *Johnson s.n.* (KEI); 3129 DA, *Johnson 88, 168* (KEI); 3229 AA, *Johnson 81, 758* (KEI)
clavatum *L.*, 3128 BA, *Bolus 10374* (BOL); 3129 AB, *Roux 618* (NBG)
carolinianum *L.* var. carolinianum, 3030 CC, *Roux 662* (NBG); 3128 BC, *Hutchings & Plumstead 1627* (KEI); 3129 BD, *Cawe 110* (KEI); 3129 DA, *Schelpe 239* (NU); 3130 AA, *Ward 206* (NU)

SELAGINELLALES

SELAGINELLACEAE
Selaginella *Beauv.*
dregei *(Presl) Hieron.*, 3128 DB, *Hutchings 2284* (KEI); 3129 BC, *Leighton s.n.* (BOL); 3129 AB, **Bachman 9* (B); 3129 BD, *Cawe 342* (KEI)
caffrorum *(Milde) Hieron.*, 3028 AA, *Roux 1343* (NBG); 3127 AA, *Britten s.n.* (GRA); 3129 DA, *Hardcastle 289* (NBG)
kraussiana *(Kunze) A. Br.*, 3127 AA, *Royffe 140* (GRA); 3128 BC, *Cawe 479* (KEI, BOL); 3128 CB, *Baur 13* (SAM); 3129 DA, *Hutchings & Johnson 2239* (KEI); 3228 AD, *Mcloughlin 728* (BOL); 3228 BD, *Johnson students s.n.* (KEI)
mittenii *Bak.*, 3030 CC, *Roux 670* (NBG); 3228 AD, *Pegler 893* (GRA)

EQUISETALES

EQUISETACEAE
Equisetum *L.*
ramosissimum *Desf.*, 3028 BD, *Tyson 1622* (BOL, SAM); 3030 CC, *Johnson 2050* (KEI); 3127 AA, *Pegler & Kolbe s.n.* (BOL); 3127 CA, *Hutchings & Johnson 1670* (BOL, KEI); 3128 DB, *Schonland 3813* (GRA); 3129 DA, *Hardcastle 290* (NBG); 3228 AD, *Pegler 553* (BOL)

OPHIOGLOSSALES

OPHIOGLOSSACEAE
Ophioglossum *L.*
polyphyllum *A. Br.*, 3128 AA, *Roux 1194* (NBG)
reticulatum *L.*, 3129 AC, *Hutchings 957* (KEI); 3129 DA, *Schelpe 355* (NU)
vulgatum L., 3029 DA, *Hilliard & Burtt 7706* (NU); 3128 DB, *Hutchings 2281* (KEI)

MARATTIALES

MARATTIACEAE
Marattia *Swartz*
fraxinea *J.E. Sm. ex J.F. Gmel.* var. salicifolia *(Schrad.) C. Chr.*, 3128 BC, *Cawe 736* (BOL); 3128 CB, *Baur s.n.* (GRA); 3128 DB, *Mcloughlin s.n.* (BOL); 3129 BC, *Meaker s.n.* (NU); 3129 BC, *Sims 2451* (GRA); 3129 BD, *Roux 614* (NBG); 3129 DA, *Bolus 10372* (BOL)

FILICALES

OSMUNDACEAE
Osmundia *L.*
regalis *L.*, 3029 DD, *Schelpe 5070a* (BOL); 3030 CC, *Abbott 2661* (KEI); 3128 AD, *Hutchings 1264* (BOL, KEI); 3128 CB, *Baur s.n.* (GRA, SAM)
Todea *Willd.*
barbara *(L.) T. Moore*, 3030 CC, *Roux 656* (NBG); 3129 BC, *Mcloughlin 722* (BOL); 3129 BC, *Cawe 30* (KEI); 3129 DA, *Schelpe 361* (NU)

GLEICHENIACEAE
Gleichenia *J.E. Sm.*
polypodioides *(L.) J.E. Sm.*, 3029 BB, *Sr. Wheeler s.n.* (NU); 3127 DB, *Mcloughlin 121* (BOL); 3128 CB, *Hutchings 2205* (KEI, NH); 3129 BD, *Roux 611* (NBG); 3129 DA, *Jacot Guillarmod s.n.* (GRA)
umbraculifera *(Kuntze) T. Moore*, 3128 BC, *Hutchings 2036* (BOL, KEI); 3128 CB, *Baur 10* (SAM), *178* (GRA); 3129 BC, *Cawe 79* (KEI); 3130 AA, *Taylor 2618* (NBG)

SCHIZAEACEAE
Schizaea *J.E. Sm.*
pectinata *(L.) Swartz*, 3129 BD, *Johnson 176* (KEI)
tenella *Kaulf.*, 3127 DB, *Flanagan 2755* (PRE)
Anemia *Swartz*
dregeana *Kunze*, 3030 CC, *Abbott 2457* (KEI); 3128 CA, *Hutchings & Plumstead 2076* (BOL, KEI); 3129 CC, *Wells 3540* (GRA); 3129 DA, *Hutchings & Johnson 2247* (KEI); 3228 BD, *Roux 551* (NBG); 3228 CB, *Flanagan 285* (GRA)
Mohria *Swartz*
caffrorum *(L.) Desv.*, 3027 DB, *Roux 1207* (NBG); 3028 AD, *Johnson 713* (KEI); 3029 AD, *Taylor 5487* (NBG); 3028 DD, *Barker 6158* (NBG); 3029 AB, *Schelpe 5062* (BOL); 3127 CB, *Schelpe 5831* (BOL); 3128 BC, *Hutchings 125* (KEI); 3128 CA, *Cawe 839* (KEI); 3129 AC, *Hutchings 1010* (BOL, KEI); 3129 DA, *Hutchings & Johnson 2243* (KEI); 3228 BD, *Johnson 270* (KEI)
Lygodium *Swartz*
kerstenii *Kuhn*, 3129 DA, *Hutchings 2192* (BOL, E, KEI, NH). The identity of this material is still being investigated.

MARSILEACEAE
Marsilea *L.*
macrocarpa *Presl*, 3127 AA, *Pegler & Kolbe 1528a* (BOL); 3127 DB, *Pegler 1528* (BOL); 3127 AD, *Kolbe & Pegler 193* (GRA); 3129 DA, *Hardcastle 317* (NBG); 3228 AB, *Roux 543* (NBG)
capensis *A. Br.*, 3129 DA, *Hardcastle 317*

CYATHEACEAE
Cyathea *J.E. Sm.*
dregei *Kunze*, 3030 BC, *Roux 664* (NBG); 3128 BC, *Hutchings 1067* (KEI); 3128 CB, *Baur 161* (GRA, SAM); 3129 BB, *Roux 612* (NBG); 3129 BC, *Hutchings 1997* (KEI); 3130 AA, *Griffen s.n.* (GRA)
capensis *(L. f.) J.E. Sm.*, 3128 CB, *Baur 194* (SAM)

HYMENOPHYLLACEAE
Trichomanes *L.*
reptans *Swartz*, 3129 DA, *Schelpe 5043* (BOL)
rigidum *Swartz*, *grid unknown, *Drège s.n.* (BM)
pyxidiferum *L.* var. melanotrichum *(Schlechtd.) Schelpe*, 3030 BC, *Roux 648* (NBG); 3129 BC, *Strey 8581* (BOL); 3129 DA, *Hutchings 1177* (BOL, KEI)

DENNSTAEDTIACEAE
Blotiella *Tryon*
natalensis *(Hook.) Tryon*, 3129 BC, *Sim s.n. sub CH 3744* (PRE)
glabra *(Bory) Tryon*, 3129 DA, *Bolus 10368* (BOL); *grid unknown, *Drège s.n.* (K, BM)
Pteridium *Gled. ex Scop.*
aquilinum *(L.) Kuhn* subsp. aquilinum, 3029 AB, *Schelpe 5084* (BOL); 3129 BD, *Cawe 81* (KEI); 3129 CB, *Roux 567* (NBG); 3129 DA, *Schelpe 359* (NU); 3130 AA, *Schelpe 5084* (BOL)
Hypolepis *Bernh.*
sparsisora *(Schrad.) Kuhn*, 3030 CC, *Roux 666* (NBG); 3129 BC, *Cawe 229* (KEI); 3129 CB, *Roux 566* (NBG); 3129 DA, *Hutchings & Johnson 2238* (KEI)

VITTARIACEAE
Vittaria *J.E. Sm.*
isoetifolia *Bory*, 3030 CC, *Roux 657* (NBG); 3129 BC, *Strey 8868* (BOL); 3129 DA, *Mcloughlin 776* (BOL); 3129 DA, *Hutchings 1175* (BOL, KEI); 3228 CB, *Flanagan 1809* (GRA)

ADIANTACEAE/PTERIDACEAE
Acrostichum *L.*
aureum *L.*, 3130 AA, *Ward 911* (NU, KEI)
Pityrogramma *Link*
calomelanus *(Swartz) Link* var. aureoflava *(Hook.) Weath. ex Bailey*, 3029 AB, *Schelpe 5056* (BOL); 3129 DA, *Hutchings & Johnson 2246* (KEI)
Adiantum L.
capillus-veneris *L.*, 3127 AA, *Esterhuysen 29208* (BOL); 3127 BC, *Schelpe 5837* (BOL); 3128 BC, *Hutchings 2216* (KEI); 3129 DA, *Hutchings & Johnson 2235* (KEI); 3129 CC, *Hoffman 014* (KEI)
poiretii *Wikstr.*, 3028 DD, *Barker 6166* (NBG); 3029 DA, *Strey 6393* (BOL); 3128 CA, *Hutchings & Plumstead 1092* (KEI)
raddianum *Presl*, 3129 DA, *Hutchings & Plumstead 2056* (KEI)
Pteris *L.*
vittata *L.*, 3029 CC, *Hutchings 1354* (BOL, KEI); 3128 AB, *Baur 225* (SAM); 3129 CB, *Roux 569* (NBG)
cretica *L.*, 3028 DD, *Barker 6170* (NBG); 3029 DA, *Law s.n.* (NU); 3127 AA, *Royffe 240* (GRA); 3128 BC, *Hutchings & Johnson M8* (KEI); 3128 CA, *Johnson 331* (BOL, KEI)
buchananii *Bak. ex Sim*, 3129 DA, *Hardcastle 282* (NBG); 3129 CC, *Hoffman 16* (KEI)
dentata *Forssk.*, 3030 CC, *Roux 667* (NBG); 3127 DB, *Cawe 842* (BOL, KEI); 3128 CA, *Wells 3599* (GRA); 3129 DA, *Giffen s.n.* (GRA); 3228 BD, *Johnson students s.n.* (KEI)
catoptera *Kunze*, 3029 AB, *Schelpe 5064* (BOL); 3029 DA, *Taylor 5325* (NBG); 3128 BC, *Cawe 451* (KEI, BOL); 3129 DA, *Schelpe 360* (NU); 3228 BD, *Johnson students 2* (KEI)
Cheilanthes *Swartz*
eckloniana *(Kunze) Mett.*, 3029 AB, *Mcloughlin 726* (BOL); 3029 DD, *Schelpe 5076* (BOL); 3127 AA, *Pegler 1636* (BOL); 3128 CA, *Cawe 759* (BOL, KEI); 3128 BD, *Roux 563* (NBG)
inaequalis *(Kunze) Mett.*var. buchananii *(Bak.) Schelpe*, 3029 AD, *Taylor 5486* (NBG); 3030 CC, *Roux 679* (NBG); 3128 DB, *Roux 563* (NBG); 3129 DA, *Flanagan 2580* (SAM)
parviloba *(Swartz) Swartz*, grid unknown, *Young 3675* (PRE)
hirta *Swartz*, 3029 CC, *Hutchings 1383* (BOL, KEI); 3127 AA, *Schelpe 5840* (BOL); 3127 CA, *Hutchings & Johnson 1660* (KEI); 3128 CA, *Cawe 897* (BOL, KEI); 3129 AB, *Hutchings 1353* (KEI); 3129 DA, *Roux 595* (NBG)
involuta *(Swartz) Schelpe & N.C. Anthony*
var. involuta, 3128 DB, *Hutchings 96* (KEI)
var. obscura *(N.C. Anthony) N.C. Anthony*, 3227 DB, *Flanagan 1240* (GRA)
viridis *(Forssk.) Swartz*
var. viridis, 3128 BC, *Lewis 2853* (SAM); 3129 DA, *Roux 597* (NBG); 3228 BB, *Hutchings 650* (KEI)
var. macrophylla *(Kuntze) Schelpe & N.C. Anthony*, 3029 AD, *Taylor 5221* (NBG); 3030 CC, *Strey 8718* (BOL); 3129 BC, *Hutchings & Johnson 2251* (KEI); 3129 DA, *Hutchings 1176* (BOL, KEI); 3228 DB, *Hutchings 650* (KEI); 3228 BC, *NBG 365/73* (BOL); 3228 BD, *Roux 553* (NBG); *grid unknown, *Drège s.n.* (K)
var. glauca *(Sim) Schelpe & N.C. Anthony*, 3030 CC, *Roux 661* (NBG); 3127 DB, *Cawe 232* (KEI); 3129 DA, *Roux 597* (BOL); 3130 AA, *Schelpe 5078* (BOL)
quadripinnata *(Forssk.) Kuhn*, 3028 AD, *Roux 1377* (NBG); 3028 DD, *Barker 6168* (NBG); 3029 AD, *Taylor 5483a* (NBG); 3029 DA, *Taylor 5324* (NBG); 3127 AA, *Pegler 1634* (BOL); 3127 BC, *Schelpe 5843* (BOL); 3127 DB, *Esterhuysen 29146* (BOL); 3128 AB, *Johnson & Hutchings 1077* (BOL, KEI); 3128 BC, *Hutchings 2167* (BOL, KEI)
multifida *(Swartz) Swartz*
subsp. multifida, 3127 AA, *Schelpe 5838* (BOL); 3129 DA, *Mcloughlin s.n.* (BOL)
subsp. lacerata *N.C. Anthony & Schelpe*, *grid unknown, *Drège s.n.* (LZ, B)
bergiana *Schlechtd.*, 3029 AD, *Taylor 5230* (NBG); 3029 DA, *Taylor 5324* (NBG); 3030 CC, *Roux 652* (NBG); 3128 BC, *Hutchings 23* (KEI); 3128 CB, *Bear 11, 42* (SAM); 3129 DA, *Schelpe 352* (NU); 3228 BD, *Johnson 14* (KEI)
concolor *(Langsd. & Fisch.) R. & A. Tryon*, 3030 CC, *Roux 691* (NBG); 3128 CA, *Cawe 737* (BOL, KEI); 3129 DA, *Schelpe 349* (NU); 3228 BD, *Johnson students 12* (KEI); 3229 AA, *Johnson 753* (KEI)
Pellaea *Link*
calomelanos *(Swartz) Link*, 3029 AD, *Taylor 5484* (NBG); 3127 CB, *Schelpe 5883* (BOL); 3127 CA, *Hutchings 1607* (BOL, KEI); 3128 DB, *Johnson 36* (KEI); 3129 DA, *Schelpe 356* (KEI); 3228 AD, *Compton 17731* (NBG)

POLYPODIACEAE
Pyrrosia *Mirb.*
africana *(Kunze)Ballard*, 3129 BC, *Strey 8583* (BOL); 3129 DA, *Roux 571* (NBG); 3228 AD, *Ward 5710* (NU); 3228 BB, *Wells 3566* (GRA); 3228 BD, *Johnson students 5a* (KEI)
Loxogramme *(Blume) Presl*
lanceolata *(Swartz) Presl*, 3128 CB, *Baur 1* (GRA) *s.n.* (SAM); 3129 DA, *Hardcastle 267* (NBG)
Polypodium *L.*
vulgare *L.*, 3029 CB, *Tyson 1642* (SAM); 3128 BC, *Cawe 625* (BOL, KEI)
polypodioides *(L.) Hitchc.* subsp. ecklonii *(Kunze) Schelpe*, 3128 BC, *Hutchings 47* (KEI); 3129 AB, *Roux 619* (NBG); 3128 CB, *Baur s.n.* (SAM)
Pleopeltis *H.B.K. ex Willd.*
macrocarpa *(Bory ex Willd.) Kaulf.*, 3029 AD, *Taylor 5228* (NBG); 3128 CB, *Baur s.n.* (BOL); 3129 DA, *Hutchings & Johnson 2242* (KEI)
schraderi *(Mett.) Tardieu*, 3028 DD, *Barker 6167*(NBG); 3128 BA, *Cawe 624* (KEI, BOL); 3128 CA, *Hutchings & Plumstead 2078* (KEI)
Microgramma *Presl*
lycopodioides *(L.) Copel.*, 3130 CC, *Johnson 2075* (KEI)
Microsorium *Link*
punctatum *(L.) Copel.*, 3130 CC, *Johnson 2077* (KEI); 3129 DA, *Hutchings & Johnson 2234* (KEI)
scolopendrium *(Burm. f.) Copel.*, 3129 DA, *Hutchings & Johnson 2231* (KEI); 3130 AC, *Hutchings 2215* (KEI)
ensiforme *(Thunb.) Schelpe*, 3129 DA, *Burtt Davy 3895* (PRE)

DAVALLIACEAE
Nephrolepis *Schott*
exaltata *(L.) Schott*, 3129 DA, *Hutchings & Johnson 2229* (KEI)
Oleandra *Cav.*
distenta *Kunze*, 3129 DA, *Roux 591* (NBG)
Davallia *J.E. Sm.*
chaerophylloides *(Poir.) Steud.*, 3030 CC, *Roux 678* (NBG); 3129 BC, *Leighton s.n.* (BOL); 3129 BD, *Hutchings 2024* (KEI); 3129 DA, *Schelpe 5030* (BOL); 3130 AA, *Schelpe 5076* (BOL)

ASPLENIACEAE
Asplenium *L.*
anisophyllum *Kunze*, 3129 BC, *Strey 8871* (BOL)
prionitis *Kunze*, grid unknown, *Drège s.n.*; 3030 CC, *Roux 649* (NBG); 3128 BC, *Hutchings 44* (KEI); 3129 DA, *Hutchings 1174* (KEI); 3228 BD, *Johnson students 9* (KEI)
boltonii *Hook. ex Schelpe*, 3029 BB, *Schlechter 6229* (GRA); 3128 BC, *Hutchings s.n.* (BOL, KEI); 3129 DA, *Mcloughlin s.n.* (BOL)
gemmiferum *Schrad.*, 3030 CC, *Roux 650* (NBG); 3127 DB, *Mcloughlin s.n.* (BOL); 3129 DA, *Schelpe 346* (NU); 3228 BD, *Roux 549* (NBG)
gemmiferum *Schrad.* × flexuosum *Schrad.*, 3129 DA, *Mcloughlin s.n.* (BOL)
protensum *Schrad.*, 3029 BB, *Schlechter 6635* (GRA); 3128 AD, *Cawe 673* (BOL, KEI); 3128 AC, *Cawe 800* (BOL, KEI); 3129 DA, *Mcloughlin 755* (BOL)
sandersonii *Hook.*, 3228 BD, *Roux 545* (NBG)
stoloniferum *Bory*, 3127 AA, *Pegler 1637* (BOL); 3128 AB, *Johnson & Hutchings 1079* (BOL, KEI)
trichomanes *L.*, 3128 AD, *Roux 1379* (NBG)
platyneuron *(L.) Oakes*, 3027 DB, *Roux 1208* (NBG)
monanthes *L.*, 3028 DD, *Barker 6169* (NBG); 3127 AA, *Royffe 240* (GRA); 3128 AD, *Cawe 665* (BOL, KEI)
lunulatum *Swartz*, 3030 CC, *Roux 653* (NBG); 3128 BC, *Cawe 454* (BOL), *456* (BOL, KEI); 3128 BC, *Hutchings 119* (KEI); 3129 DA, *Hutchings & Johnson 2240* (KEI); 3228 BD, *Johnson students 13* (KEI)
erectum *Bory ex Willd.* var. erectum, 3127 DB, *Cawe 868* (BOL, KEI); 3128 AC, *Cawe 799* (BOL, KEI); 3128 BA, *Cawe 623* (BOL, KEI); 3128 BC, *Cawe 489, Hutchings 40, 119* (BOL, KEI); 3129 DA, *Mcloughlin 783* (BOL)
inaequilaterale *Willd.*, 3129 DA, *Schelpe 5042* (BOL)
dregeanum *Kunze*, 3129 DA, *Johnson 108* (KEI); *grid unknown, *Drège s.n.*
theciferum *(H.B.K.) Mett.* var. concinnum *(Schrad.) Schelpe*, 3029 AD, *Taylor 5229* (NBG)
rutifolium *(Berg.) Kunze*, 3030 CC, *Roux 646* (NBG); 3127 DB, *Mcloughlin 1* (BOL); 3129 BC, *Hutchings & Johnson 2248* (KEI); 3129 CB, *Wells 3489* (GRA); 3129 DA, *Hutchings 1174a* (KEI); 3228 BD, *Johnson students 11* (KEI)

lobatum *Pappe & Rawson*, 3128 AD, *Cawe 670* (BOL, KEI)
varians *Wall. ex Hook. & Grev.* subsp. fimbriatum *(Kunze) Schelpe*, 3129 DA, *Hardcastle 255a* (NBG)
adiantum-nigrum *L.* var. solidum *(Kunze) J.P. Roux*, 3228 CB, *Flanagan 146* (PRE)
splendens *Kunze*, 3030 CC, *Roux 647* (NBG); 3128 BC, *Hutchings 122* (KEI); 3128 BC, *Hutchings 670* (BOL, KEI); 3128 CA, *Hutchings 388* (KEI); 3129 CC, *Wells 3547* (GRA); 3129 DA, *Hutchings & Johnson 1137* (KEI); 3228 BD, *Johnson students 11* (KEI)
simii *Braithwaite & Schelpe*, 3130 AA, *Bayliss 2223* (BOL, KEI)
aethiopicum *(Burm. f.) Becherer*, 3127 AA, *Royffe 197* (GRA); 3127 AD, *Schelpe 5832* (BOL); 3127 DB, *Flanagan 2580* (SAM); 3127 DB, *Cawe 865* (BOL, KEI); 3128 AC, *Cawe 805* (BOL); 3128 BC, *Cawe 484, Hutchings* (BOL, KEI)

Ceterach *D.C.*
cordatum *(Thunb.) Desv.*, 3127 BC, *Schelpe 5842* (BOL); 3128 CA, *Cawe 892* (BOL, KEI); 3129 DA, *Mcloughlin s.n.* (BOL), *794* (BOL); 3228 BD, *Roux 556* (NBG)

THELYPTERIDACEAE

Thelypteris *Schmidel*
madagascariensis *(Fee) Schelpe*, 3128 BA, *Cawe 734* (KEI, BOL)
interrupta *(Willd.) K. Iwats.*, 3128 BC, *Cawe 726* (KEI): 3129 BD, *Cawe 80* (KEI); 3129 CB, *Wells 3479* (NBG); 3129 DA, *Roux 602* (NBG); 3229 AA, *Johnson 756* (KEI)
pozoi *(Lagasca) Morton*, 3029 BB, *Cawe 1003* (BOL); 3127 DC, *Cawe 901* (BOL, KEI)
dentata *(Forssk.) E. St. John*, 3127 DB, *Cawe 898* (BOL, KEI); 3129 DA, *Schelpe 5033* (BOL); 3130 AA, *Schelpe 5075* (BOL); 3228 BD, *Moll 5747* (BOL); 3229 AA, *Johnson 756* (KEI)
gueinziana *(Mett.) Schelpe*, 3029 AB, *Schelpe 5058a* (BOL); 3129 DA, *Hutchings & Johnson 2249* (BOL, KEI)
bergiana *(Schlechtd.) Ching*, 3029 CB, *Schlechter 6512* (NBG); 3129 DA, *Roux 581* (NBG); 3228 BD, *Roux 555* (NBG)

Macrothelypteris *(H. Ito) Ching*
torresiana *(Gaud.) Ching*, 3129 DA, *Roux 1971* (NBG)

ATHYRIACEAE

Athyrium *Roth*
schimperi *Moug. ex Fée*, 3029 BC, *Schlechter 6585* (GRA)

Cystopteris *Bernh.*
fragilis *(L.) Bernh.*, 3029 BB, *Schlechter 6638* (GRA); 3029 BC, *Schlechter 6585* (GRA)

LOMARIOPSIDACEAE

Elaphoglossum *Schott*
hybridum *(Bory) Brack*, 3127 DB, *Mcloughlin 106* (PRE)
macropodium *(Fée) T. Moore*, 3129 DA, *Roux 586* (NBG); 3129 BC, *Sim 2461* (PRE)
conforme *(Swartz) J. Sm.*, 3129 DA, *Roux 586* (NBG); grid unknown, *Taylor 2602* (NBG)
acrostichoides *(Hook. & Grev.) Schelpe*, 3128 BC, *Hutchings 1977* (KEI); 3128 CA, *Cawe 871* (BOL)
angustatum *(Schrad.) Hieron.*, 3129 BC, *Cawe 231* (KEI)

ASPIDIACEAE/DRYOPTERIDACEAE

Woodsia *R. Br.*
montevidensis *(Spreng.) Hieron.* var. burgessiana *(Gerr. ex Hook. & Bak.) Schelpe*, 3129 CB, *Schlechter 6526* (GRA)

Dryopteris *Adans.*
squamiseta *(Hook.) Kuntze*, 3028 AD, *Johnson 709* (KEI)
athamantica *(Kunze) Kuntze*, 3029 AB, *Hutchings 2133* (KEI, NU); 3029 CB, *Schlechter 6556* (GRA); 3128 CA, *Cawe 767* (BOL, KEI); 3128 DB, *Fr. Abbott 29* (GRA)
inaequalis *(Schlechtd.) Kuntze* sens. lat., 3029 AD, *Taylor 5482* (NBG); 3029 BC, *Schlechter 6512* (GRA); 3129 AB, *Schelpe 5063* (BOL); 3129 CB, *Roux 565* (NBG); 3129 DA, *Hutchings 571* (BOL, KEI); 3228 BD, *Johnson students 8* (KEI)
dracomontana *Schelpe & N.C. Anthony*, 3128 AD, *Roux 1376* (NBG)

Cyrtomium *Presl*
caryotideum *(Wall. ex Hook. & Grev.) Presl* var. micropterum *(Kunze) C. Chr.*, 3128 AD, *Flanagan s.n.* (SAM); 3029 BB, *Schlechter 6635* (GRA); 3127 DC, *Cawe 900* (KEI, BOL); 3128 BC, *Cawe 327* (BOL, KEI); 3129 DA, *Hutchings & Johnson 2232* (KEI)

Polystichum *Roth*
transkeiense *Jacobsen*, 3029 DA, *Taylor 5227* (NBG); 3129 BC, *Strey 8869* (BOL, NU); 3129 DA, *Jacobsen 4301* (BOL)
pungens *(Kaulf.) Presl*, 3128 AB, *Hutchings & Johnson 1081* (BOL, KEI); 3128 BC, *Cawe 443, Hutchings 118* (BOL, KEI); 3129 DA, *Schelpe 357, 358* (NU)
luctuosum *(Kunze) T. Moore*, 3128 AC, *Cawe 777* (BOL, KEI); 3128 AD, *Cawe 660* (BOL, KEI); 3128 BC, *Hutchings 118* (KEI)
transvaalense *N.C. Anthony*, 3129 DA, *Wager s.n. sub CH 2905* (PRE); 3127 DB, *Mcloughlin s.n. sub CH 7677* (PRE); 3127 DA, *Young s.n. sub TM 511c* (PRE)
monticola *N.C. Anthony & Schelpe*, 3129 BC, *Cawe 228* (KEI)

Arachniodes *Blume*
foliosa *(C. Chr.) Schelpe*, 3029 CD, *Adams 164* (UN)

Rumohra *Raddi*
adiantiformis *(G. Forst.) Ching*, 3129 DA, *Roux 593* (NBG); 3228 AD, *Ward 5715* (NU)

Ctenitis *(C. Chr.) C. Chr. ex Tardieu*
lanuginosa *(Willd. ex Kaulf.) Copel.*, 3128 BA, *Cawe 735* (BOL, KEI); 3128 CB, *Baur 221* (GRA); 3129 DA, *Mcloughlin 785* (BOL); *grid unknown, *Drège s.n.* (LZ)

BLECHNACEAE

Blechnum *L.*
giganteum *(Kaulf.) Schlechtd.*, 3127 DB, *Cawe 867* (BOL, KEI); 3128 BC, *Hutchings & Johnson M7* (BOL, KEI); 3129 DA, *Hardcastle 288* (NBG)
capense *(L.) Burm. f.*, 3129 BD, *Johnson 179* (KEI); 3130 AA, *Schelpe 5074* (BOL)
tabulare *(Thunb.) Kuhn*, 3029 AB, *Schelpe 5061* (BOL); 3029 CC, *Cawe 945* (BOL); 3128 BC, *Hutchings 2165* (KEI, NH); 3129 AB, *Roux 520* (NBG)
australe *L.* var. australe, 3028 BA, *Matthews 957* (NBG); 3127 AA, *Royffe 90* (GRA); 3128 AB, *Hutchings & Johnson 1082* (BOL, KEI); 3127 DC, *Cawe 899* (BOL, KEI); 3128 AD, *Cawe 666* (BOL, KEI); 3128 CA, *Cawe 840* (BOL, KEI); 3128 CB, *Baur s.n.* (GRA)
punctulatum *Swartz*
var. punctulatum, 3129 AD, *Johnson 710* (KEI); 3128 CB, *Cawe 680* (BOL, KEI); 3129 DA, *Williams 102* (NU)
var. atherstonei *(Pappe & Raws.) Sim*, 3128 CB, *Baur 640* (SAM)
var. intermedium *Sim*, 3128 AC, *Taylor 2599* (NBG); 3129 BC, *Taylor 2632* (NBG)
var. krebsii *(Kunze) Sim*, 3129 DA, *Mcloughlin 800* (BOL); 3129 DA, *Roux 583* (NBG); 3129 BC, *Taylor 2632* (NBG)

Stenochlaena *J. Sm.*
tenuifolia *(Desv.) T. Moore*, *grid unknown, *Drège s.n.* (LZ)

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Taxonomy and leaf anatomy of the genus *Ehrharta* (Poaceae) in southern Africa: the Ramosa group

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Keywords: Capensis, culm anatomy, *Ehrharta*, Fynbos, leaf anatomy, Poaceae, taxonomy

ABSTRACT

The Ramosa species group in the genus *Ehrharta* is distinguished morphologically by small spikelets with sterile lemmas similar to each other, with tips rounded, truncate or mucronate, with sides glabrous, scabrous or shortly hairy, and with bases appendaged and usually bearded. The rectangular intercostal long cells with sinuous walls, the dome-shaped stomata with a raised rim surrounding the pore aperture, the absence of epicuticular wax and the microhairs without a tapering distal cell are diagnostic anatomically. The Ramosa group is composed of two species: *E. ramosa* (Thunb.) Swartz subsp. *ramosa*; subsp. *aphylla* (Schrad.) Gibbs Russell and *E. rehmannii* Stapf subsp. *rehmannii*; subsp. *filiformis* (Nees) Gibbs Russell; subsp. *subspicata* (Stapf) Gibbs Russell. All taxa are linked by intermediates to one or two others in the group. The closest relationship of the Ramosa group is to the Calycina species group, on the basis of both morphological and anatomical characters.

UITTREKSEL

Die Ramosa-spesiegroep in die genus *Ehrharta* word morfologies onderskei deur klein blompakkies met steriele eenderse lemmas, met punte gerond, afgeknot of stekelpuntig, met kante onbehaar, skurf of kortharig, en met basisse met aanhangsels en gewoonlik bebaard. Die reghoekige tussenribbige lang selle met gekartelde wande, die koepelvormige huidmondjies met 'n verhewe rand rondom the porie-opening, die afwesigheid van epikutikulêre was en die mikrohare sonder 'n spitslopende distale sel is anatomies kenmerkend. Die Ramosa-groep bestaan uit twee spesies: *E. ramosa* (Thunb.) Swartz subsp. *ramosa*; subsp. *aphylla* (Schrad.) Gibbs Russell en *E. rehmannii* Stapf subsp. *rehmannii*; subsp. *filiformis* (Nees) Gibbs Russell; subsp. *subspicata* (Stapf) Gibbs Russell. Alle taksons word deur tussenvorms aan een of twee ander taksons in die groep gekoppel. Die naaste verwantskap van die Ramosa-groep is met die Calycina-spesiegroep, op grond van morfologiese sowel as anatomiese kenmerke.

INTRODUCTION

Previous papers in this series have outlined the seven provisional species groups of *Ehrharta* in southern Africa, and have dealt with the Setacea, Villosa and Dura groups (Gibbs Russell & Ellis 1987, 1988; Ellis 1987a; 1987b; Gibbs Russell 1987a, 1987b). This paper examines the Ramosa group, which is distinguished from the other *Ehrharta* species groups by the small spikelet size (4–9 mm long), sterile lemmas similar to each other, with tips rounded, truncate or mucronate, with sides glabrous, scabrous or shortly hairy, and with bases appendaged and usually bearded (Figure 1). The rectangular intercostal long cells with sinuous walls, the dome-shaped stomata with a raised rim surrounding the pore aperture, the absence of epicuticular wax and the microhairs without a tapering distal cell are diagnostic anatomically. In contrast to the species groups covered already, in which taxa are relatively easy to define and may be distinguished by clear-cut characters, the five taxa comprising the Ramosa group intergrade and few consistently reliable characters adequately separate the species and subspecies. Therefore, the taxa accepted here must be considered as noda in a continuum of intra-group variability. Despite the difficulty, it is desirable to treat the Ramosa group taxa formally for the following reasons: 1, most specimens fall within the noda, as here defined, and only a comparative few are intermediates; 2, the great differences between the 'ends' of the continuum, both morphological and ecological, require a means of distinguishing between, e.g., the robust bladeless subshrub of rocky places common at high altitudes (*E. ramosa* subsp. *ramosa*) and the delicate trailing herb with thin soft leaves from moist sheltered sites (*E. rehmannii* subsp. *filiformis*); 3, each of the taxa has a distinct geographical range.

The two taxa that are common in the Fynbos Biome are large plants of widespread distribution, *E. ramosa* subsp. *ramosa* and subsp. *aphylla*. They have been recognized from very early times in the study of the southern African flora (Thunberg 1794). The smaller, less common plants with more limited distribution were first treated as separate species by Stapf (1897, 1900). Previous to his classification, specimens of these taxa had been attributed to *E. ramosa* and *E. aphylla*.

As a result of the confusing pattern of variation and the inadequate early classification of the Ramosa group, its nomenclature has also been somewhat difficult. For each of the five taxa in the group a lectotype or neotype was designated.

METHODS

Methods adopted for previous papers of this series were followed here (Gibbs Russell & Ellis 1987). The descriptions and keys were prepared through the DELTA computer system (Dallwitz 1984).

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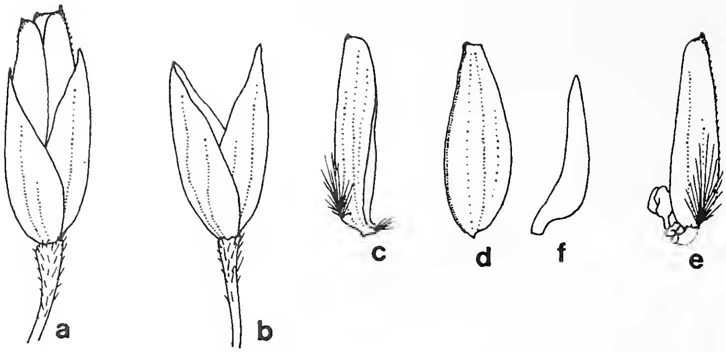

FIGURE 1.—Spikelet of *E. ramosa* subsp. *ramosa* (*Esterhuysen 8343*, PRE): a, whole spikelet; b, glumes; c, first sterile lemma; d, fertile lemma; e, second sterile lemma; f, palea.

TAXONOMY

Key to species in the Ramosa group

Plants robust, strongly suffrutescent; leaf blades absent or reduced; sterile lemmas usually mucronate .... *E. ramosa*
Plants not robust, usually herbaceous; leaf blades present, expanded; sterile lemmas usually muticous ..... *E. rehmannii*

1. **Ehrharta ramosa** *(Thunb.) Swartz* in Transactions of the Linnean Society 5: 49 (1802). Thunb.: 336 (1818); Thunb. ed. Schultes: 335 (1823); Schrader: 2077 (1821); Schrader in Schultes: 1370 (1830); Trinius: 25 (1839); Nees: 205 (1841); Steudel: 7 (1855); Stapf: 677 (1900); Chippindall 39 (1955); Smook & Gibbs Russell: 55 (1985). Type: Thunberg (sheet 8855), UPS, lecto. here designated – IDC microfiche 1036 in PRE!

Melica ramosa Thunb.: 21 (1794). *Ehrharta digyna* Thunb.: 66 (1794).

Perennial, tufted, erect or straggling, long-rhizomatous, often robust, suffrutescent. *Rhizomes* woody, branched, naked or with cataphylls. Cataphylls glabrous, thin, or thickened. *Culms* many, erect or geniculate, woody or wiry and persistent, hollow, crowded at the ends of the rhizomes, branched at base and branching above, usually with many fascicled branches, the internodes sometimes with globose orange gall-like swellings at their base. Young shoots intravaginal. *Leaves* not basally aggregated. Culm leaves with sheaths not overlapping, blades absent or reduced, sheaths held away from the culm. Basal sheaths loose, deciduous, or persistent, papery, or membranous, grey, not bearing blades. Ligule a membrane fringed with hairs, about 1 mm long.

Inflorescence a raceme or a panicle, open or contracted, of several to many appressed, spreading or nodding spikelets, closely subtended or enveloped below by uppermost leaf sheath or exserted from it, main axis sinuous around appressed spikelets. *Spikelets* pedicellate, distinctly compressed laterally, (5,5–)6–7,5(–9) mm long, about 2–3 mm across. Pedicels usually with short stiff hairs. Glumes keeled, subequal, slightly shorter than rest of spikelet to considerably longer than rest of spikelet, yellowish or green, somewhat spreading or appressed to lemmas at maturity. Lower glume 5–7-nerved, acute. Upper glume 3–5-nerved, acute. *Florets* with lemmas decidedly firmer than the glumes, keeled. Sterile lemmas similar in shape and texture, laterally compressed, sides flat. Lower sterile lemma about $^{3}/_{4}$ length of upper sterile lemma to about equalling length of upper sterile lemma, with keel and margin parallel; base not stipitate, with auriculate appendages, bearded; sides glabrous or sometimes scabrous, often short-hairy on the margins, dull, with 2–3 fairly distinct to faint longitudinal ribs and rarely with up to 12 faint transverse corrugations; tip truncate or slightly oblique, usually mucronate, but sometimes aristate or sometimes muticous. Upper sterile lemma similar to lower sterile lemma, but often with transverse corrugations, substipitate, longer than lower sterile lemma. *Fertile floret* with lemma differing from sterile lemmas, strongly laterally compressed and sides unornamented, not exceeding upper sterile lemma or sometimes slightly longer than both sterile lemmas, 7–9-nerved, sides glabrous or scabrous on nerves; tip truncate, midnerve sometimes submucronate. Palea thinner than lemma, $^{3}/_{4}$ or more as long as lemma. Lodicules 2, fleshy at base, and membranous above, ciliate at margins, or glabrous. Stamens 6. Anthers 2,5–4 mm long, yellow. Ovary glabrous. Stigmas white. Caryopsis not seen (spikelets shed early).

Both subspecies of *E. ramosa* inhabit Mountain Fynbos, growing in xerophytic to mesophytic open habitats.

This species differs from *E. rehmannii* in its robust, consistently suffrutescent habit, bladeless or nearly bladeless leaves, and sterile lemmas with usually submucronate to shortly aristate tips. Although the break between the five taxa in the Ramosa group is greatest between the two species as based on the above characters, the separation is not complete, for a number of intermediates are known. The specimens are discussed in more detail under particular subspecies.

Although the majority of *E. ramosa* specimens can be identified to subspecies, there are a number which show intermediate states for the characters that separate the taxa: the size of the plant can vary with age, and in any case may not be apparent on a poor herbarium specimen; the openness of the inflorescence can vary with developmental stage, with young inflorescences of subsp. *aphylla* showing erect spikelets; glume length is variable in subsp. *ramosa*, being either slightly longer or shorter than the sterile lemmas. The difficulty of separating the subspecies has led to their treatment in synonymy as early as Trinius (1839), or as infraspecific taxa (Gluckmann ex Adamson 1942). The two taxa are treated here as subspecies because each has a distinct geographical range. Intermediate specimens are discussed under subsp. *aphylla*.

There are three sheets of *E. ramosa* in Thunberg's herbarium. Sheet 8855 was chosen as the lectotype because it is the most complete, showing typical culm size and branching, leaf sheaths and several inflorescences.

Key to subspecies

Plants very robust, culms to 5 mm across; glumes usually slightly shorter than sterile lemmas; inflorescence usually contracted, pedicels erect to ascending; leaves bladeless .... 1a. *E. ramosa* subsp. *ramosa*

Plants robust, culms to 2,5 mm across; glumes slightly to considerably longer than sterile lemmas; inflorescence usually open, pedicels spreading to reflexed; leaves rarely with small blades .... 1b. *E. ramosa* subsp. *aphylla*

1a. **Ehrharta ramosa** *(Thunb.) Swartz* subsp. **ramosa**

Culms markedly robust, woody, 300–1 000 mm long, to 5 mm across, erect, or geniculate. Culm leaves with blades absent, at most the blades occasionally represented by an apiculate inrolled tip to the sheath. *Inflorescence* a contracted raceme 30–140 mm long with appressed spikelets. *Spikelets* pedicellate, the pedicels held erect. Glumes 4,5–8 mm long, usually slightly shorter than rest of spikelet or sometimes slightly longer than rest of spikelet. Lower sterile lemma about ¾ length of upper sterile lemma to about equalling length of upper sterile lemma; tip strongly truncate, usually purple-tinged for about ¼ of lemma length. Fertile floret not exceeding upper sterile lemma (shorter or subequal).

Subsp. *ramosa* is distinguished from subsp. *aphylla* by its more robust habit and very thick culms, its narrow inflorescence with erect appressed spikelets, glumes that are often shorter than the lemmas, and the markedly truncate sterile lemmas with purple-tinged ends. It is characteristic of Mountain Fynbos although it extends into Grassy Fynbos and occurs at low altitudes in the eastern part of its range. Its distribution is shown in Figure 2. Subsp. *ramosa* has the widest range of the five taxa in the Ramosa species group, although subsp. *aphylla* extends slightly further to the north and *E. rehmannii* subsp. *rehmannii* extends slightly further to the east. It is unusual in *Ehrharta* for a taxon to have both a western and an eastern distribution and yet be absent from the Cape Peninsula-Caledon area. Subsp. *ramosa* grows in sandy or stony Table Mountain Sandstone (TMS) or lateritic soils, often in rocky places, at altitudes of 90 to 2 200 m; and is common at high altitudes. Flowering occurs from October to January.

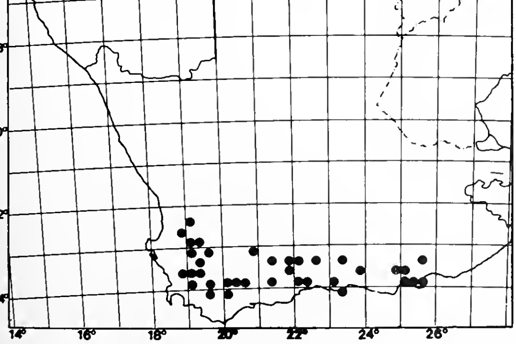

FIGURE 2.—Distribution of *E. ramosa* subsp. *ramosa*.

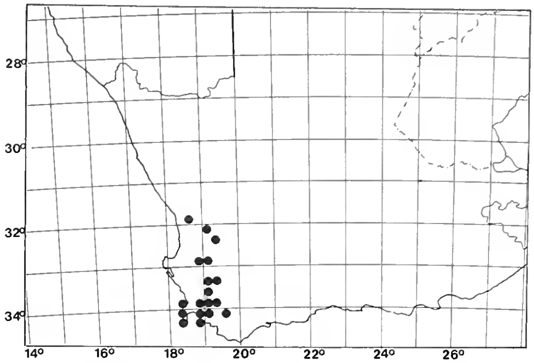

FIGURE 3.—Distribution of *E. ramosa* subsp. *aphylla*.

1b. **Ehrharta ramosa** *(Thunb.) Swartz* subsp. **aphylla** *(Schrad.) Gibbs Russell*, stat. nov.

Ehrharta aphylla Schrad. in Göttingische gelehrte Anzeigen 1821: 2077 (1821); Schrad. in Schultes: 1369 (1830); Nees: 207 (1841); Steud.: 7 (1855); Stapf: 678 (1900). *Ehrharta ramosa* Thunb. var. *aphylla* (Schrad.) Gluckmann ex Adamson: 273 (1942); Chippindall: 39 (1955). Type: *Hesse*, apparently lost; neotype here designated: *Ecklon 914* (specimen in K with suffrutescent culms and bladeless leaves!).

E. ramosa Thunb. var. *aphylla* (Schrad.) Gluckmann ex Adamson: 273 (1942).

E. aphylla Schrad. var. *fasciculata* Stapf: 679 (1900). Type: tops of mountains, Baviaans Kloof, *Burchell 7725* (K, holo.!; photo and fragment in PRE!).

Culms not robust to robust, woody or wiry, 300–800 mm long, to 2,5 mm across, geniculate or decumbent at base. Culm leaves with blades usually absent, but occasionally present on upper leaves. *Leaf blades* when present lanceolate; to 1 mm across, to 30 mm long, rolled, erect, herbaceous, glabrous, gradually tapering at the tip. *Inflorescence* a raceme or a panicle with 1 or 2 branches, usually open or sometimes contracted, 20–90 mm long, with spikelets spreading to nodding. *Spikelets* pedicellate, the pedicels spreading to reflexed. Glumes 4,5–9 mm long, usually slightly or considerably longer than rest of spikelet but sometimes slightly shorter. Lower sterile lemma slightly shorter than upper sterile lemma, rarely purple-tinged and then only at the tips, with up to 12 corrugations; tip oblique or truncate. Upper sterile lemma usually with marked transverse corrugations. Fertile floret sometimes exceeding upper sterile lemma.

Subsp. *aphylla* differs from subsp. *ramosa* in its generally smaller size, open inflorescence with spreading to reflexed spikelets, long glumes and sterile lemmas with truncate to oblique tips that are uncommonly purple-tinged only at the tips. Its distribution is shown in Figure 3. Subsp. *aphylla* occurs only up the western mountains, and is absent from the eastern part of the range of the Ramosa group. It grows in Mountain Fynbos on sandy TMS-derived soil between rocks, often in dry microhabitats, and is reported 1–4 years after fire, from altitudes of 230–1 500 m. Flowering occurs from (July) September to January.

A number of specimens are intermediate between subsp. *aphylla* and subsp. *ramosa*. The specimens that occur in the area of sympatry of the subspecies fall into two groups: those with the long glumes of subsp. *aphylla* and the

contracted inflorescence and erect spikelets of subsp. *ramosa* (*Du Toit 1747; Esterhuysen 3930; Liebenberg 4331; The Forester 8226*) and those with the open inflorescence of subsp. *aphylla* but with the short glumes and often with the dark sterile lemmas of subsp. *ramosa* (*Andreae 705; Loxton 221; Stokoe (SAM No.) 54502*). A number of specimens from the Clanwilliam area fall into this second group of intermediates, and are leafy, often erect, and with remarkably short glumes (*Esterhuysen 14978, 32217; Liebenberg 4308; Stokoe 7809*). Within the range of subsp. *ramosa* only, there are a few specimens with typical *ramosa* spikelets and robust culms but the open inflorescence of subsp. *aphylla* (*Gibbs Russell 5683, Kensit Jan. 1914*).

Although the leaves of subsp. *aphylla* are usually bladeless or with very reduced blades, a few specimens show well developed blades (*Du Toit 1425; Ellis 648, 4673; Gibbs Russell 5668, 5672; Hanekom 1294; Richardson 62*). This may be natural or phenological variability within the taxon, or these specimens may represent a link across the species line to *E. rehmannii* subsp. *rehmannii*, although the two taxa are allopatric. Such a population at Kirstenbosch was collected in 1918 (*Page s.n.*) and 1955 (*Salter 8665*). Gluckmann in 1938 annotated the Page specimen: 'I have examined clusters of this growing in Kirstenbosch and found long-leafed forms intermingled with leafless forms'.

A second possible link across the species line is represented by specimens from the Ceres area (*Esterhuysen 28110, 28396; Stokoe 2652*). They have typical *aphylla* spikelets, but the plants tend to be slender and leafy with only about 5–10 spikelets per inflorescence, characteristics of *E. rehmannii* subsp. *filiformis*, which does not occur so far to the north.

The Hesse specimen on which Schrader based the name *aphylla* has not been found in GOET, LE, B or P, the herbaria where it was most likely to have been preserved. Pending its lucky discovery elsewhere, a lectotype or neotype must be selected. In his treatment of *Ehrharta* in Schultes (1830), Schrader cited an additional specimen, *Ecklon 914*. Nees (1832) also cited *Ecklon 914* as the type of *E. aphylla* var. *filiformis*. The descriptions of the two taxa differ, Schrader's referring to a suffrutescent plant with no leaf blades, while Nees describes a specimen with soft flat leaves and a much reduced inflorescence. Stapf (1900) states that there are two specimens marked *Ecklon 914* at Kew, one representing subsp. *aphylla* and one representing *E. rehmannii* var. *filiformis*. I have seen these specimens, annotated by Stapf, and propose that they serve as neotypes for these taxa. They cannot be lectotypes because there is no indication that either was seen by Schrader or Nees. It would be futile to attempt to find unequivocal lectotypes for the following reasons: 1, specimens labelled *Ecklon 914* represent more than one taxon; 2, Ecklon collected a number of Ramosa group specimens from different places in the Kleinrivier area and his duplicates are numerous and widely distributed, many without collection numbers; 3, the whereabouts of the personal herbaria of Schrader and Nees is not known; 4, no *Ehrharta* specimens of historical importance exist any longer at B, which is the most likely location of Nees's and Schrader's lost herbaria.

2. **Ehrharta rehmannii** *Stapf* in Kew Bulletin: 288 (1897); Stapf: 677 (1900); Chippindall: 39 (1955). Type: Outeniqua Mountains, Montagu Pass, *Rehmann 74* (K, lecto.!, here designated; photo and fragment in PRE!).

Perennial, tufted, erect or straggling, long-stoloniferous, delicate or neither distinctly delicate nor robust, not suffrutescent but culms sometimes woody below even in small plants. *Rhizomes* branched, naked or with cataphylls. *Culms* several to numerous, erect to prostrate, woody below or wiry or herbaceous, crowded at ends of rhizome, branched at base and branching above, solid or hollow, the internodes rarely with gibbous gall-like swellings at their base. Young shoots intravaginal. *Leaves* not basally aggregated. Culm leaves with sheaths not overlapping, blades well developed. Leaves auriculate, the auricles with spreading glassy hairs, produced from top of sheath and base of blade. Basal sheaths loose, persistent, papery or membranous, grey, yellowish or whitish, bearing blades or not bearing blades. Ligule a membrane fringed with hairs, 0,3–2 mm long. Leaf blades deciduous or persistent on basal sheaths, persistent on culm sheaths, expanded, linear or lanceolate, erect or spreading, soft or herbaceous, glabrous, scabrous or hairy, with marginal vein not thickened or barely thickened, tip gradually tapering.

Inflorescence a raceme or a panicle, reduced or not reduced, open or contracted, not overtopping leaves to considerably overtopping leaves, of 1 to many appressed, spreading or nodding spikelets, closely subtended or enveloped below by uppermost leaf sheath or exserted from uppermost leaf sheath, secund or not secund. *Spikelets* pedicellate, distinctly compressed laterally, 4,0–8,5 mm long. Pedicels usually with short stiff hairs. Glumes keeled, subequal, slightly shorter to slightly longer than rest of spikelet, yellowish or green, gaping widely at maturity or appressed to lemmas at maturity. Lower glume 3–7-nerved; acute to apiculate. Upper glume 1–5-nerved, acute to apiculate. *Florets* with lemmas decidedly firmer than the glumes, keeled. Sterile lemmas similar in shape and texture, laterally compressed, sides flat. Lower sterile lemma about equalling or somewhat shorter than upper sterile lemma, with keel and margin parallel; base not stipitate, with auriculate appendages, bearded or not bearded; sides glabrous, scabrous or with short hairs, dull, smooth and unornamented or with 0–3 fairly distinct to faint longitudinal ribs or with 0–6 faint transverse corrugations; tip truncate or rounded, usually muticous. Upper sterile lemma similar to lower sterile lemma but with distinct corrugations in the upper half, substipitate, longer than lower sterile lemma. *Fertile floret* with lemma differing from sterile lemmas, strongly laterally compressed and sides unornamented, not exceeding upper sterile lemma, 5–7-nerved; tip truncate. Palea thinner than lemma, $^3/_4$ or more as long as lemma. Lodicules 2, fleshy at base, or membranous above, ciliate at margins or glabrous. Stamens 6. Anthers 2,2–2,6 mm long. Caryopsis not seen (spikelets shed early).

This species usually grows in wetter habitats than *E. ramosa*, and often at lower altitudes. It differs from *E. ramosa* in its herbaceous to wiry culms, leaves with well developed blades and muticous sterile lemmas. There are three subspecies, which intergrade through a number of intermediates. These specimens are discussed below under the appropriate subspecies.

Although the two species differ in the characters mentioned above, the separation is not absolute, and a number of specimens show intermediate character conditions between *E. ramosa* subsp. *aphylla* and both *E. rehmannii* subsp. *rehmannii* and subsp. *filiformis*. These are discussed in more detail under *E. ramosa* subsp. *aphylla* above.

Stapf (1900) is responsible for the recognition of the herbaceous leafy element in the Ramosa species group, and the three subspecies treated here were all described (subsp. *rehmannii* and *subspicata*) or separated from the woody taxa (subsp. *filiformis*) by him. However, it is evident that his concepts of the divisions within the leafy taxa changed during the course of his work. In his original description of *E. rehmannii*, Stapf (1897) quotes seven syntypes. Three of these are also quoted as syntypes of *E. subspicata* (Stapf 1900), showing that his original concept of *E. rehmannii* included both taxa.

The studies reported here, based on far more specimens and a wider geographical representation than were available to Stapf, confirm his opinion that there are three herbaceous leafy taxa in the Ramosa species group. However, the boundaries between the taxa in this treatment differ from those of Stapf's as indicated by the specimens he cited. In particular, several of the narrow-leaved specimens with glabrous sterile lemmas he cited as *E. rehmannii* (including the contentious *Ecklon 914*) belong in subsp. *filiformis* rather than subsp. *rehmannii*. Several of the specimens with branched inflorescences and herbaceous glumes that Stapf cited as *E. subspicata* belong in subsp. *rehmannii*. The lectotypes and neotype were chosen from among the several specimens cited by Stapf to reflect the present concepts of each taxon.

Key to subspecies

1a Inflorescence contracted, pedicels and spikelets erect; glumes subcoriaceous .... 2c. *E. rehmannii* subsp. *subspicata*
1b Inflorescence open, pedicels spreading to reflexed and spikelets spreading to nodding; glumes membranous:
2a Inflorescence of fewer than 20(–25) spikelets, leaf blades narrower than 4 mm; sterile lemmas glabrous on sides .... 2b. *E. rehmannii* subsp. *filiformis*
2b Inflorescence of more than 20 spikelets; leaf blades to 6 mm across; sterile lemmas usually hairy on sides or tips and/or strongly scabrous on keels .... 2a. *E. rehmannii* subsp. *rehmannii*

2a. **Ehrharta rehmannii** *Stapf* subsp. **rehmannii**

Tufted, erect; neither distinctly delicate nor robust. *Culms* several to many, 300–1 000 mm long, to 2,5 mm across, usually hard, (but to 5 mm across in rare specimens with spongy culms), wiry or herbaceous, branches from upper nodes single or few. *Leaf blades* linear, to 6 mm across, 60–300 mm long, usually spreading but sometimes erect, herbaceous, scabrous on margins and keel. *Inflorescence* a raceme or a verticillate panicle (the lowest whorls sometimes with a few branches), not reduced, open, 45–120 mm long, considerably overtopping leaves, of more than 20 spreading or nodding spikelets, exserted from uppermost leaf sheath, secund. *Spikelets* (5–)6–8 mm long about 2 mm across laterally above the glumes. Pedicels spreading to reflexed. Glumes membranous, 5,5–8 mm long, gaping widely at maturity. Lower sterile lemma usually scabrous or with short hairs on ribs, keel, tips or margins, rarely glabrous, with 3 fairly distinct longitudinal ribs and sometimes with up to 6 faint transverse corrugations, tip rounded.

Subsp. *rehmannii* is distinguished from the other two subspecies by the long broad leaves, the open paniculate inflorescence with more numerous spreading to reflexed spikelets, and the sterile lemmas with scabrous to shortly hairy keel, ribs and tip. Its distribution is shown in Figure 4. This subspecies grows on streambanks and in rocky places on mountain slopes and sometimes under trees, 400–660 m, flowering from August to December.

A particularly tall, long-leaved form with thick but soft culms and numerous short spikelets (5,5–6 mm long) occurs in forests and on rocky ground at George and Knysna (*Compton 23076*; *Fourcade 5529*; *Ofsowitz 29*; *Palmer s.n.*).

A putative link between leafy specimens of *E. ramosa* subsp. *aphylla* and this subspecies has been mentioned under that taxon. A further link may be the hairiness of the sterile lemmas in subsp. *rehmannii*, which could be an elaboration of their strongly scabrous condition common in *E. ramosa* subsp. *aphylla*. The sterile lemma hairs of subsp. *rehmannii* are short and appressed and restricted to the nerves, margins and tips, thus differing considerably from the longer spreading hairs on the sides of the sterile lemmas in the *E. calycina* complex.

2b. **Ehrharta rehmannii** *Stapf* subsp. **filiformis** *(Stapf) Gibbs Russell*, stat. nov. Type: *Ecklon 914* (in part) neotype here designated (specimen in K with thin culms and small leaf blades!).

Ehrharta rehmannii Stapf var. *filiformis* Stapf: 677 (1900). Chippindall: 39 (1955); Smook & Gibbs Russell: 55 (1985).

Ehrharta aphylla Schrad. var. *filiformis* Nees: 334 (1832). Nees: 207 (1841). Kleinriviersberge zwischen Zäunen, *Ecklon*.

Ehrharta filiformis Mez: 292 (1921). Type: Kapgebiet, Kleinrivier, *Ecklon & Zeyher 85B*.

Tufted, erect or straggling, delicate or neither distinctly delicate nor robust, often growing in dense masses. *Culms* many to numerous, 120–800 mm long, 0,3–0,5 mm across, erect to decumbent or prostrate in smaller forms, usually herbaceous or sometimes woody toward base of culm, branching at upper nodes varies from seldom-branched with single branches to fascicled with many branches. *Leaves* borne all along the culms to just

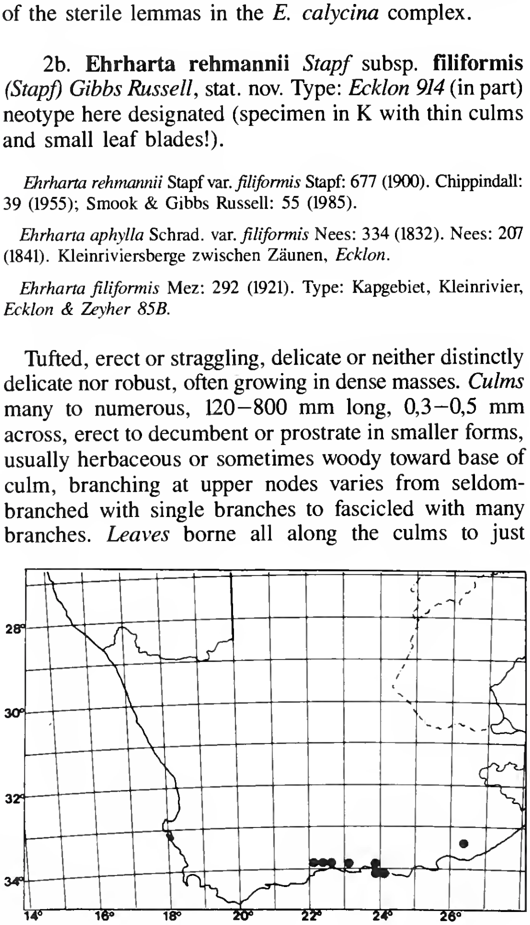

FIGURE 4.—Distribution of *E. rehmannii* subsp. *rehmannii*.

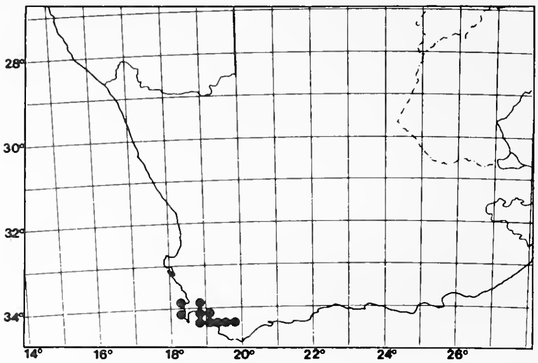

FIGURE 5.—Distribution of *E. rehmannii* subsp. *filiformis*.

below the inflorescence. Leaf blades linear, usually small, thin and soft, to 4 mm across but most leaves very fine, 15–100 mm long, spreading, sparsely glabrous. *Inflorescence* a reduced open raceme, 10–100 mm long, not or only a little overtopping leaves, of 1–15(–24) spreading to nodding spikelets, exserted from uppermost leaf sheath. *Spikelets* 4–6,5(–8) mm long. Pedicels spreading to reflexed. Glumes membranous, 4–6,5 mm long, gaping widely at maturity. Lower sterile lemma glabrous on sides, with 2–3 fairly distinct to faint longitudinal ribs and rarely with up to 6 faint transverse corrugations, tip rounded, muticous. Lemma of fertile floret rarely with very faint corrugations.

Subsp. *filiformis* is distinguished from the other two subspecies by the often delicate habit, the small, soft, thin leaf blades and the inflorescence with few spikelets borne on spreading to reflexed pedicels. Its distribution is shown in Figure 5. It grows on sandy (TMS) and humic soils, at streamsides, in moist places, and in the shade of rocks, from altitudes of 25–2 000 m, flowering from October to February. It is most commonly collected after fire.

A few specimens occur that are intermediate between subsp. *filiformis* and both other subspecies. *Gibbs Russell 5674* is a typical subsp. *filiformis* and was collected within its range, but the sterile lemma margins are hairy, a characteristic of subsp. *rehmannii*. The intermediates to subsp. *subspicata* are discussed under that subspecies.

As discussed above under *E. ramosa* subsp. *aphylla*, this taxon must be typified by a specimen of *Ecklon 914* with thin culms, soft leaves and few spikelets. There is no evidence that the Kew specimen of this description was seen by Nees, so it is designated as a neotype rather than a lectotype. A fragment of a since-destroyed specimen from Berlin, allegedly annotated by Nees, exists in PRE but it lacks a complete spikelet so therefore its identity cannot be unequivocably determined. Mez (1921) quoted Nees's (1841 not 1832) epithet as the basionym when raising the taxon to species rank, but he cited a different specimen from those cited by Nees in either publication.

2c. **Ehrharta rehmannii** *Stapf* subsp. **subspicata** *(Stapf) Gibbs Russell*, comb. et stat. nov. Type: stream from Retreat to Muizenberg, *Wolley Dod 3519* (K, lecto.!, here designated; BOL, photo and fragment in PRE!).

Ehrharta subspicata Stapf: 676 (1900), Chippindall: 39 (1955).

Tufted erect, neither distinctly delicate nor robust. *Culms* several, 300–600 mm long, to 2 mm across, erect or decumbent at base, herbaceous, branching above, the branches few and single. *Leaf blades* linear or lanceolate, 4–8,5 mm across and 30–120(–170) mm long, flat or rolled from both margins, erect, herbaceous, glabrous or margins scabrous. *Inflorescence* a narrow contracted raceme, 25–70 mm long, somewhat overtopping leaves, of 12–36 erect, appressed spikelets, usually closely subtended or enveloped below by uppermost leaf sheath. *Spikelets* 6–8,5 mm long. Pedicels erect. Glumes subcoriaceous, nerves obscure; lower glume 6–8,5 mm long; upper glume 5,5–8 mm long. Lower sterile lemma glabrous on sides, smooth and unornamented or with transverse corrugations; 0–3 ribs; 0–4 corrugations, faint; tip truncate or rounded, rarely submucronate.

Subsp. *subspicata* is distinguished from the other two subspecies by the broad erect leaves and narrow inflorescences of erect spikelets with subcoriaceous glumes. Its distribution is shown in Figure 6. It grows in sandy or gravelly soil in moist places such as streamsides and seepage areas, near sea level, flowering from October to December.

Several specimens from limestone areas near the coast appear to be intermediates between subsp. *filiformis* and subsp. *subspicata* (*Acocks 24130*; *Ellis 1295, 4660*; *Gibbs Russell 5644, 5646*). They have the somewhat delicate branched culms that are woody below and the small spikelets of subsp. *filiformis* but the narrow inflorescence and erect spikelets with subcoriaceous glumes of subsp. *subspicata*. Their distribution is not in the area of sympatry of the two subspecies, but lies to the east of the range of subsp. *filiformis* and in the middle of the range of subsp. *subspicata* (Figure 6). The limestone area where these specimens were collected is noted for its distinctive local flora (Bond & Goldblatt 1984). However, because of the general difficulty of delimiting taxa in the Ramosa group and the paucity of specimens, no formal taxonomic ranking is applied at this time to the entity represented by these specimens.

A single specimen, *Von Breitenbach 60*, appears to be intermediate between subsp. *subspicata* and subsp. *rehmannii*. It has the erect leaves and narrow inflorescence with erect spikelets of subsp. *subspicata* but the membranous glumes and scabrous-keeled sterile lemmas of subsp. *rehmannii*.

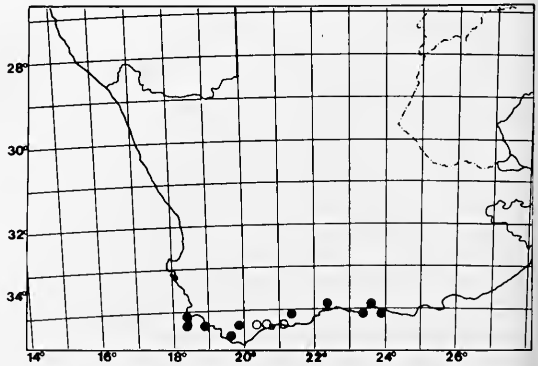

FIGURE 6.—Distribution of *E. rehmannii* subsp. *subspicata*. The 'limestone' intermediates to subsp. *filiformis* are shown by open dots.

LEAF BLADE ANATOMY

The leaf blade anatomy of the species of the Ramosa group is distinctive and distinguishes this group from the other seven species groups in *Ehrharta* (Gibbs Russell & Ellis 1987). However, the leaf anatomy of the five taxa constituting the Ramosa group exhibits no clear structural disjunctions between the taxa themselves. A large proportion of the specimens studied have anatomy intermediate between adjacent taxa and it appears from this voucher sample as if the taxa recognized only on morphology reflect trends of specialization in this species group. This is confirmed by the fact that a number of herbarium specimens are intermediate between the taxa as defined and a continuous and reticulate variation pattern is also evident in external morphological characters, in accord with the anatomical evidence.

The identifications of the anatomical voucher specimens naturally also reflect this variation pattern with a disproportionately large number of intermediates. This situation is further exacerbated by taxa with a suffrutescent habit, usually with caducous leaves which hamper leaf anatomical studies. In these taxa only atypical morphological specimens possessing leaf blades were suitable for examination. The anatomical sample was, therefore, not fully representative of all the taxa, particularly as far as anatomical vouchers closely matching type specimens is concerned.

For these reasons it is obvious that detailed anatomical descriptions and diagnoses of individual taxa are impractical, particularly as the taxa are barely separable morphologically, being recognized as two species with five subspecies. It has, therefore, been decided to give a full anatomical description for the Ramosa group as a whole followed by brief comments on the anatomical trends in each of the constituent taxa.

Transverse section

The leaf blade is always loosely inrolled from both margins (Figures 8A; 9A; 11A, C; 13A; 14A, C; 15A, D) and there is no evidence of infolding. The margins themselves range from rounded and blunt to tapering to the pointed projection of Figure 15E. The midrib is consistently a median vascular bundle only, without associated parenchyma development (Figures 8A; 9A, D; 11A, C, E; 13A; 14A, C, E; 15A, D). Successive first order bundles are separated by 2–5 smaller bundles but this pattern or arrangement differs in different specimens of the same taxon or even on opposite halves of the same blade, as in Figure 15A where either two or four third order bundles are located between the midrib and the first lateral first order bundle on either side.

Ribs and furrows may be absent (Figures 11E, F; 13A, B; 14A–F; 15A, B) or slight ribs may be present over the bundles (Figures 8B; 9B, E; 11A–D; 15E). Both conditions appear to occur in all taxa. The mesophyll generally accommodates a well developed, centrally located bulliform cell group, the central cell of which may be large and shield-shaped (Figures 11D, F; 13B; 14F). The chlorenchyma is of the compact type with small to medium, isodiametric or angular cells (Figures 9B, E; 11B, D, F; 13B; 14B, D, F; 15B). These cells are as large as or slightly larger than the parenchyma sheath cells with the chloroplasts often peripherally located. The cell walls are not straight but there is a definite tendency in all taxa for some of the walls to have slight indentations, particularly in the abaxially situated cells (Figures 9B, E; 11D, F; 13B). These resemble small invaginations of the walls but do not appear to be homologous with arm cells. They require further study but present technical difficulties as perfect fixation is needed for their elucidation.

The chlorenchyma tissue sometimes displays a somewhat radiate arrangement in thicker leaves with 4–6 chlorenchyma cell layers (Figures 9B, E; 11D, F; 13B). This pattern is not evident in thinner leaves of 2–3 cell layers (Figures 14B, D, F; 15B). The thicker leaves tend to have elongated, angular chlorenchyma cells whereas in thinner leaves they are more equidimensional.

Abaxial epidermis

Costal and intercostal zones are always clearly differentiated (Figures 8C, E; 12A, C; 13C; 14G; 15C, F). The intercostal long cells are elongate-rectangular with the anticlinal walls sinuous but not appearing inflated (Figures 8D, F; 9C; 12B, D; 13D). There is a tendency towards a fusiform, hexagonal shape in a few specimens (Figure 14H) but this species group can be characterized by the rectangular shape of the long cells and their very sinuous walls (Figures 10A, C; 16A, C, E, F).

Successive long cells in a file are separated from one another by single short cells, short cell pairs, hooks, microhairs or stomata, and very seldom adjoin one another. This arrangement along a given file alternates with that of adjacent long cell files resulting in a distinct brickwork pattern which is particularly conspicuous with the SEM (Figure 16C, E). Cell size and shape is uniform across the width of each intercostal zone.

Two files of stomata usually occur in each interstomatal zone, the stomata in a file being separated by single interstomatal long cells. The stomata are clearly dome-shaped and their structure is consistent throughout the group (Figures 8D; 12B, D; 13D; 14H). With the SEM the stomata are seen to possess a distinct, raised rim surrounding the pore aperture and they are not associated with wax deposits (Figures 10B, D; 16D, F). Epicuticular wax is also not typical of this group but may be present as very fine platelets (Figure 10D).

Costal silica bodies are variable in shape, being of the irregular dumbbell-shaped type (Figures 8D, F; 12B, D; 13D). Costal zones are narrow, seldom exceeding three cells in width.

Prickle hairs occur in all taxa but vary in form and frequency of occurrence. They vary continuously between those with very short barbs (Figures 8F; 9C; 13D; 15F) to types with elongate barbs which resemble macrohairs (Figures 8D; 12C; 15C). These latter types are unicellular and do not have specialized epidermal cells associated with their bases and, therefore, are not macrohairs by definition. Both types may be either costal or intercostal although the costal prickles on any given specimen are larger than the intercostal hooks.

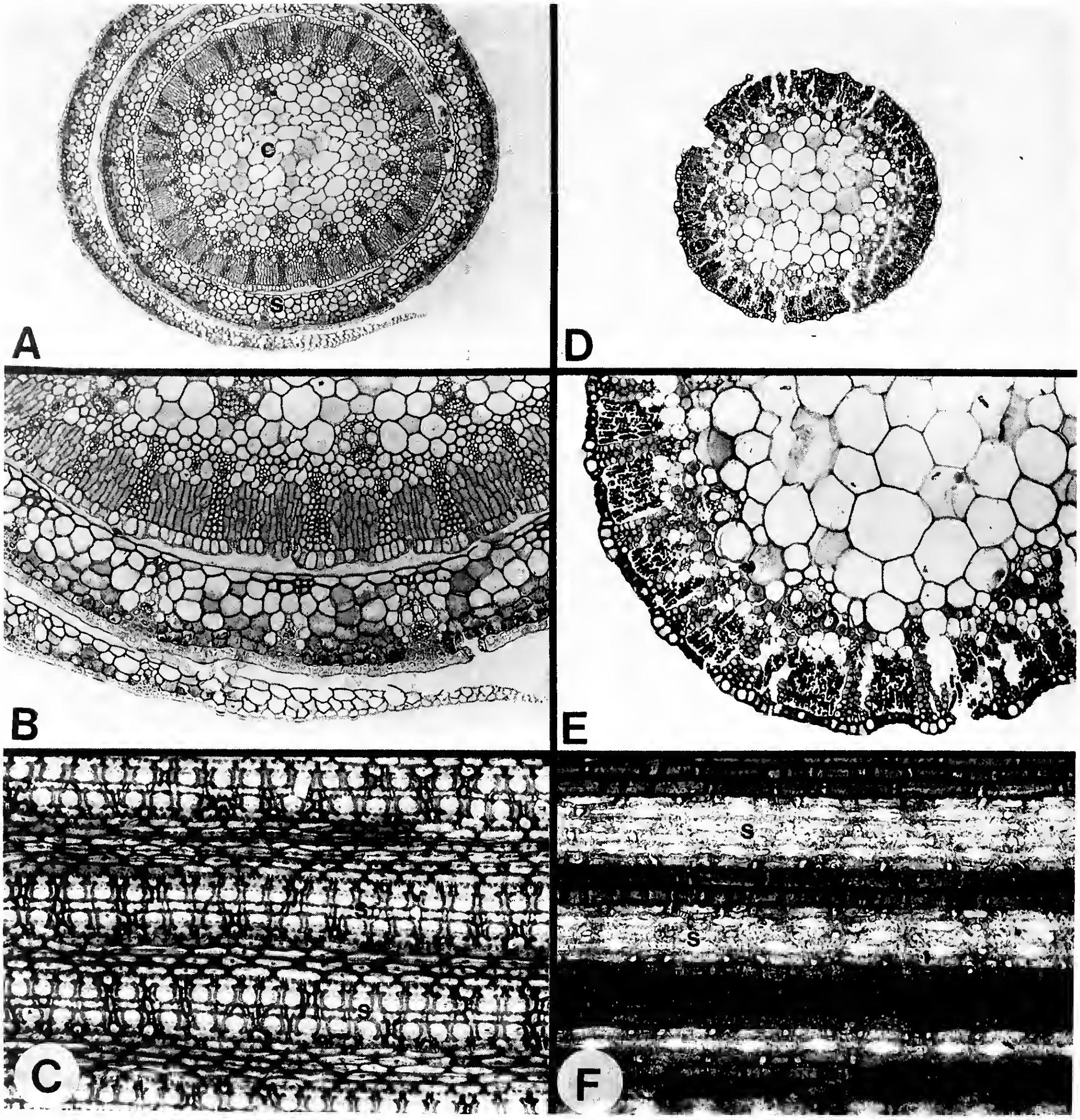

FIGURE 7.—Culm anatomy of *Ehrharta ramosa*. A–C, *E. ramosa* subsp. *ramosa*, transverse section: A, culm (c) and surrounding leaf sheath (s), × 100; B, detail of culm and leaf sheath vasculature and mesophyll tissue, × 250; C, culm epidermis showing stomatal files (s) in the intercostal zones between successive sclerenchyma girders, × 250. A, B, *Ellis 634*; C, *Ellis 5525*. D–F, *E. ramosa* subsp. *aphylla*, *Ellis 4634*, transverse section: D, culm outline, × 100; E, detail of mesophyll, vasculature and pith, × 250; F, epidermal structure illustrating alternating costal and intercostal zones, the latter with the stomatal files (s), × 400.

Microhairs are common and with the aid of the SEM are seen to be of a characteristic type (Figures 10B, D; 16B, D, F, H). The basal and distal cells are almost equal in length. The distal cell is deciduous and has a blunt apex which does not taper but the hair has a consistent width throughout its length. This type of microhair occurs in all taxa of this species group but nowhere else in *Ehrharta*.

This leaf anatomy is diagnostic for the Ramosa species group and serves to distinguish it from the other species groups in the genus. A definite anatomical trend is evident within the group, from specimens with relatively thick leaf blades, in which the chlorenchyma cells are rather elongated with cell wall indentations and displaying a somewhat radiate arrangement, to very thin leaves. These have isodiametric chlorenchyma cells without wall indentations or radiate-type arrangement. This continuum is paralleled by a trend for the margins to become more tapering and for the epidermal prickles to become smaller and fewer in number. However, these anatomical trends do not appear to be reflected in the classification of this species group and are assumed to be of no taxonomic relevance.

E. ramosa

Leaf blades in this species are absent or minute and, if present, are short-lived and caducous. As a result very few specimens possess leaf blade material and, consequently, are unsuitable for comparative anatomical study

of the leaf blade. All specimens with typical morphology were devoid of leaf blades and only culms were available for study. The results are briefly described below and illustrated in Figure 7.

The culm may be encircled by a leaf sheath which has overlapping margins (Figure 7A), a very thick cuticle, stomata, vascular bundles and chlorenchyma only in the outer cell layers (Figure 7B). Often the bladeless sheaths are also dehiscent and absent (Figure 7D).

The culm outline is circular (Figure 7A, D) with a simple epidermis. The stomata are adjacent to the chlorenchyma zones with the subsidiary cells being flush with the epidermal cells (Figure 7B). No prickles or other epidermal appendages are present.

A discontinuous ring of chlorenchyma is present beneath the epidermis. Each chlorenchyma zone consists of 5–8 radially arranged columns of tabular cells, 2–3 cells deep (Figure 7B, E). These zones are separated by the sclerenchyma girders of the peripheral vascular bundles and are bounded internally by a continuous ring of sclerenchyma and collenchyma in which the peripheral vascular bundles are embedded (Figure 7B, E). This sclerenchymatous ring encloses the central parenchymatous pith which may or may not contain vascular bundles near the periphery (Figure 7A, D).

The vascular bundles in the culms of *E. ramosa* subsp. *ramosa* are arranged in two rings, a ring situated in the pith tissue and a ring embedded in the sclerenchymatous ring (Figure 7A). In subsp. *aphylla* there is only a single ring associated with the sclerenchyma (Figure 7D). This

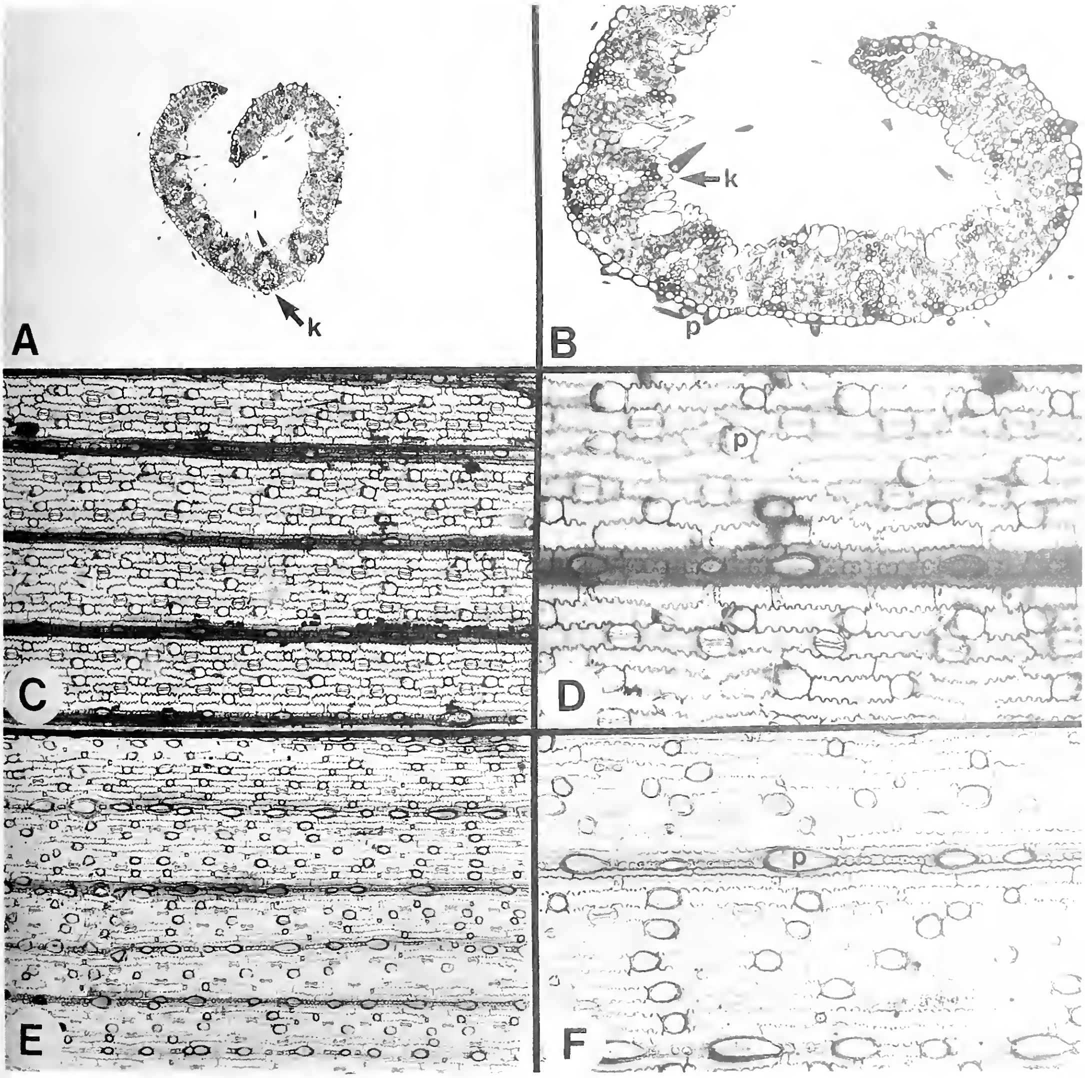

FIGURE 8.—Leaf blade anatomy of *Ehrharta ramosa* subsp. *ramosa*. A, B, transectional anatomy: A, inrolled outline of leaf blade with undifferentiated keel (k), × 100; B, anatomical detail with many prickles (p) in both epidermides, × 250. C–F, abaxial epidermis: C, cell arrangement, × 160; D, detail of costal and intercostal prickle hairs (p), intercostal long cells and stomata, × 400; E, cell arrangement and numerous prickle hair bases, × 160; F, detail of costal and intercostal prickles (p), long cells, silica bodies and stomata, × 400. A–D. *Ellis 4694*; E, F, *Ellis 1632*.

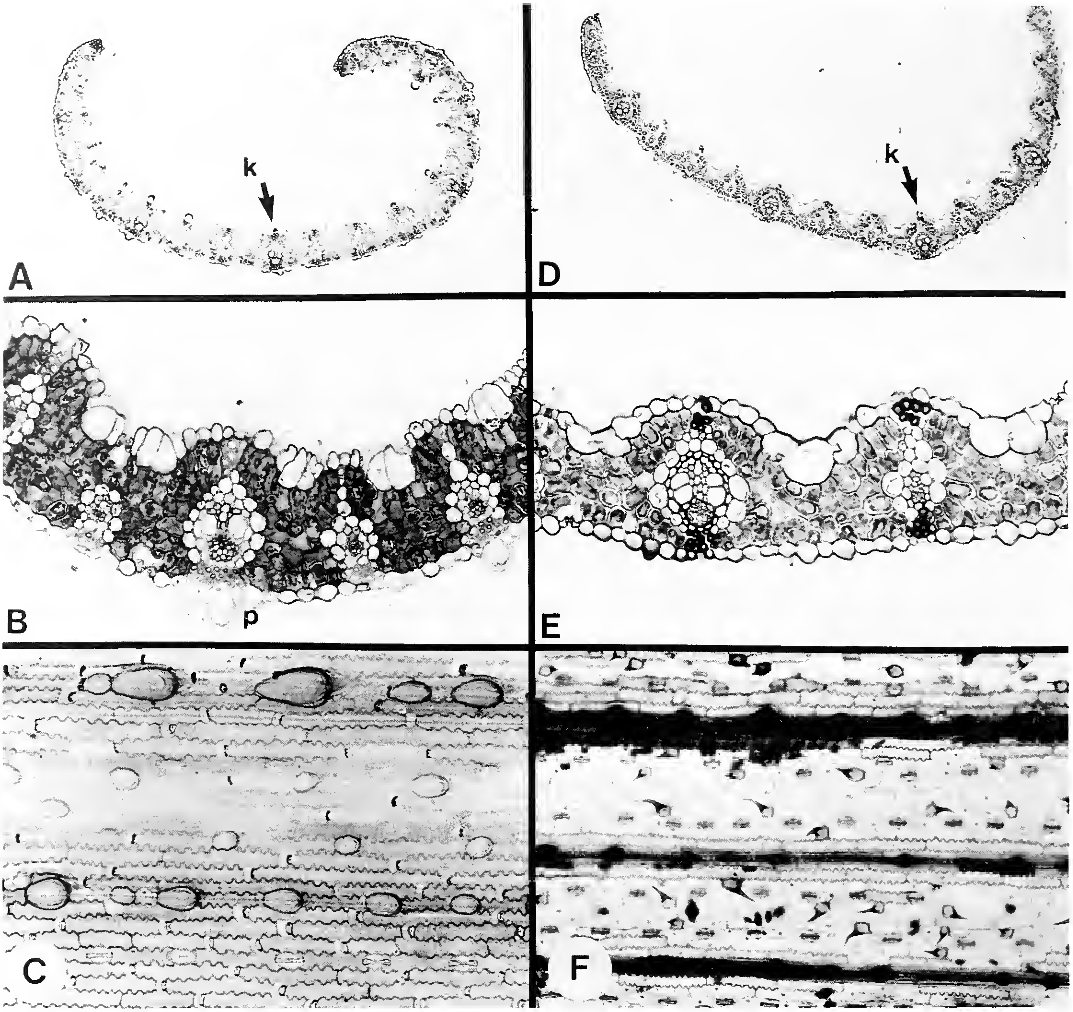

FIGURE 9.—Leaf blade anatomy of *Ehrharta ramosa* subsp. *aphylla*. A, B, leaf transverse section: A, loosely inrolled leaf outline and absence of keel (k), × 100; B, chlorenchyma and vascular bundle detail; note slight invaginations of chlorenchyma cell walls and prominent abaxial prickle hair base (p), × 400; C, abaxial epidermis showing rectangular, sinuous long cells and large costal prickle hairs, × 400. D, E, leaf in transverse section: D, outline with median vascular bundle only (k), × 100; E, chlorenchyma detail, × 400. F, abaxial epidermis showing costal prickles and intercostal hooks, × 250. A–C, *Ellis 2235*; D–F, *Ellis 4673*.

is a reflection of the difference in size and robustness of these subspecies. The vascular bundles have a clearly developed mestome sheath but the parenchyma sheath is not clear and appears to be replaced by the parenchyma or sclerenchyma ground tissue (Figure 7B, E). This was also noted by De Wet (1960).

The culm epidermis reflects this internal anatomy with alternating bands of stomatal files overlying the chlorenchyma zones, and thickened epidermal cells overly the sclerenchyma girders (Figure 7C, F). The form of the costal cells overlying the girders appears to differ between *E. ramosa* subsp. *ramosa* (Figure 7C) and subsp. *aphylla* (Figure 7F) and this may be a taxonomically important difference between these two taxa. However, a larger study sample is needed before this can be substantiated.

E. ramosa subsp. *ramosa*

Two anatomical voucher specimens (*Ellis 1632, 4694*) have been identified as belonging to this taxon although they both deviate from the taxon diagnosis in possessing leaf blades. They are both suffrutescent and woody but also possess leaf blades and have erect pedicels. They, therefore, resemble *E. rehmannii* subsp. *subspicata* in the latter two characters but this taxon is not generally suffrutescent. These specimens, therefore, are not typical subsp. *ramosa* specimens but were the only plants found which also possessed leaves and, consequently were suitable for this leaf anatomy study. They appear to represent very young flowering plants with recent vegetative growth, perhaps in response to physical damage. Nevertheless, they do not represent typical examples of this subspecies and the anatomical results must be evaluated accordingly.

The anatomy of subsp. *ramosa* conforms closely to that given for the Ramosa species group (Figure 8). The leaf in transection exhibits all the characteristic features of this species group and even slight cell wall invaginations are

visible (Figure 8B). The numerous prickle hair bases evident in the epidermis are a notable feature (Figure 8B).

The abaxial epidermis is dominated by the large number of prickle hairs present (Figure 8C–F), both in the costal and intercostal zones. These may be either typical prickles with short barbs (Figure 8F) or macrohair-like with much longer barbs (Figure 8D). The abundance of these prickle hairs appears to be a feature of this species with reduction in their size and number in several specimens of *E. rehmannii*. The silica bodies in subsp. *ramosa* are elongated dumbbell-shaped and tend to be shorter than in *E. rehmannii*. The microhairs are typical of those so diagnostic of the Ramosa species group (Figure 10B).

Specimens examined

CAPE.—3319 (Worcester): Hex River Mts, Milner Peak (–AD), *Ellis 5525* (culm only). 3321 (Ladismith): Langeberge, Cloete's Pass (–DC), *Ellis 634* (culm only), *Ellis 4694* (leaves with reduced blades). 3323 (Willowmore): Uniondale Dist., Uniondale Poort (–CA), *Ellis 1632* (short leaf blades).

E. ramosa subsp. *aphylla*

Typical material of this taxon is also without leaf blades, as in *Ellis 4634*. The voucher material which was assigned to this taxon once again presented problems with identification as all plants found with leaf blades were either sterile or only had very young inflorescences. Positive identification was, therefore, not possible because the position of the pedicels (whether reflexed or not) was not yet visible.

The anatomy of *Ellis 2235* is virtually identical to that of subsp. *ramosa*, both in transection (Figure 9A, B) and the abaxial epidermis (Figure 9C). The large prickle hair bases enchance this resemblance as do the slight cell wall indentations (Figure 9B).

Another specimen, *Ellis 4673*, which is intermediate to *E. rehmannii* subsp. *rehmannii* in spikelet characters, resembles the anatomy of *E. rehmannii* subsp. *rehmannii* more closely than that of subsp. *ramosa*. This is particularly evident in the adaxial ribs and furrows in the leaf section (Figure 9E) which generally is very similar to that of *Ellis 4697* and *4699* (Figure 11B, D), *E. rehmannii* subsp. *rehmannii*. However, the epidermal features of this specimen do not corroborate this resemblance with *E. rehmannii* but, then, neither do they suggest affinities with other *E. ramosa* specimens. Although the very small hooks are unusual, the micro-

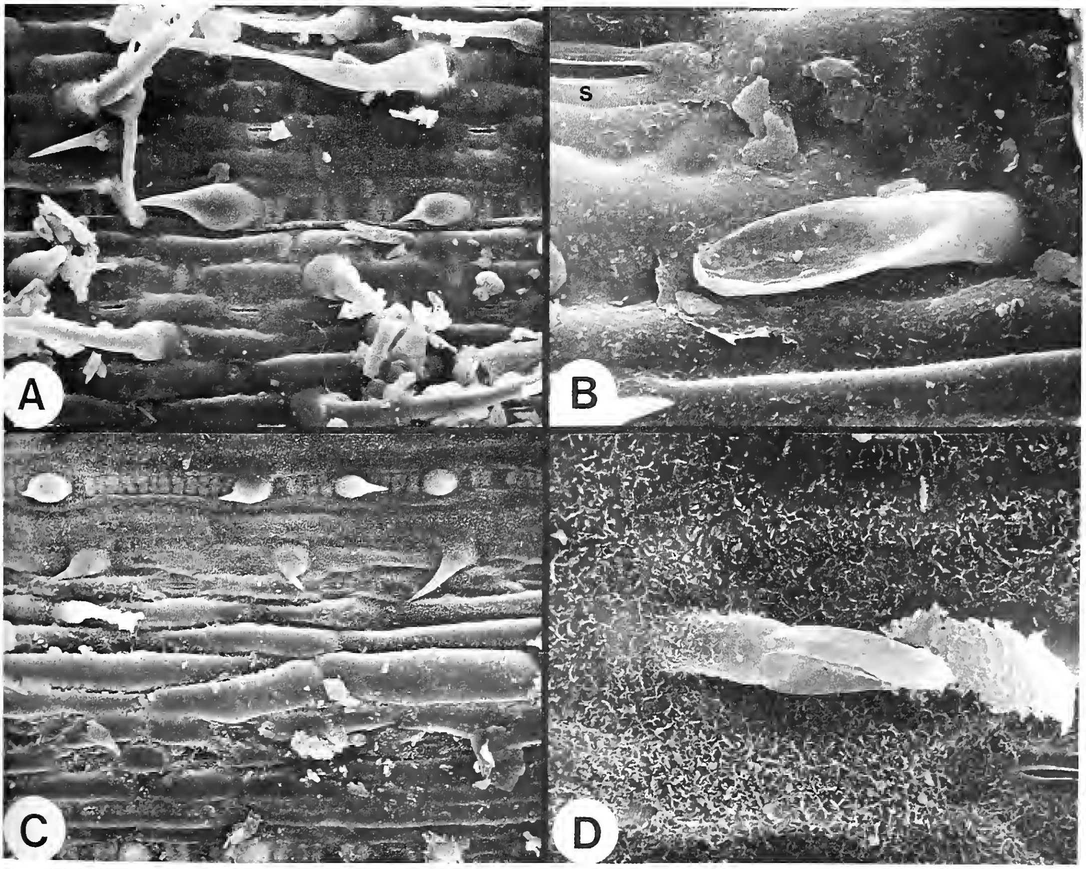

FIGURE 10.—Scanning electron micrographs of the abaxial epidermis of *Ehrharta ramosa*. A, B, *E. ramosa* subsp. *ramosa*, *Ellis 4694*: A, intercostal prickle hairs, stomata and rectangular long cells, × 200; B, microhair with distal cell not tapering and stoma (s) with distinct rim and without associated wax deposits, × 1 000. C, D, *E. ramosa* subsp. *aphylla*, *Ellis 4673*: C, inflated, rectangular intercostal long cells, stomata and hooks; costal zones with prickles and silica bodies, × 200; D, microhair with exuding distal cell and stoma with distinct rim, × 1 000.

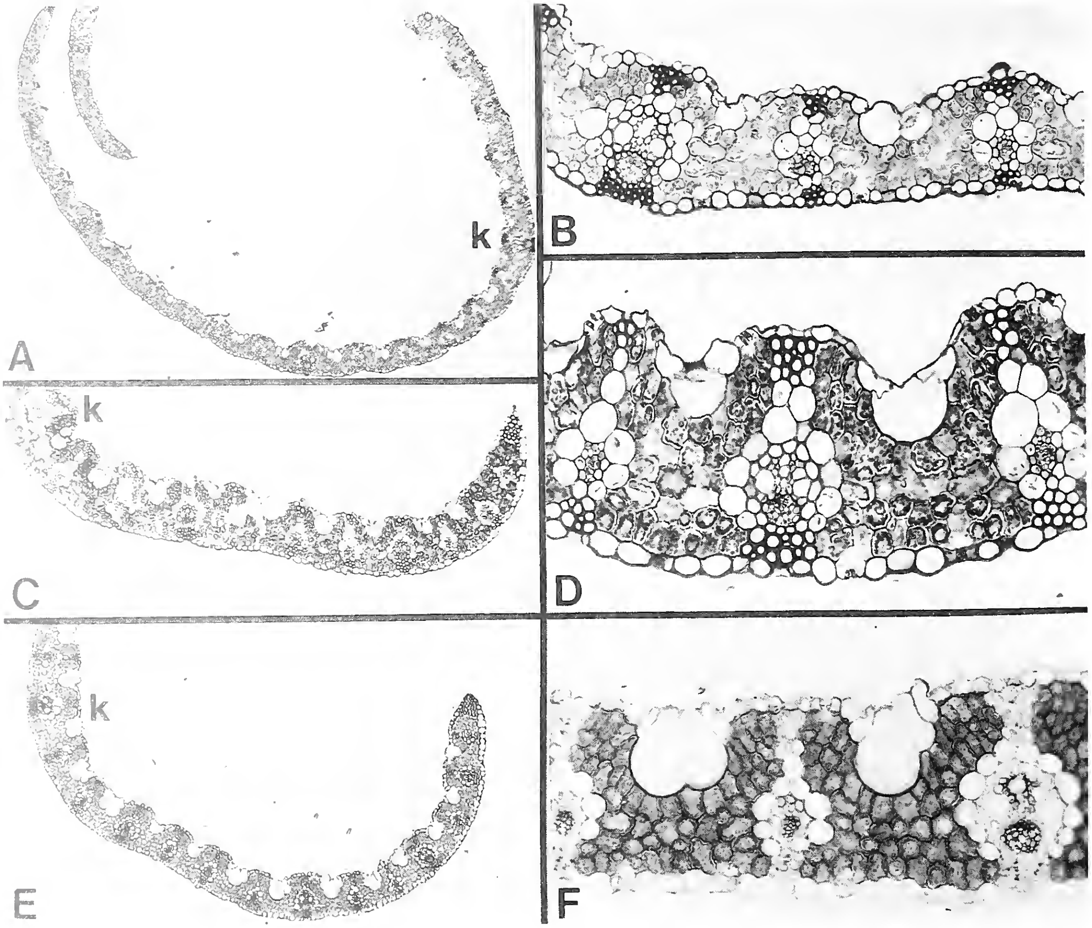

FIGURE 11.—Transectional leaf blade anatomy of *Ehrharta rehmannii* subsp. *rehmannii*. A, B, *Ellis 4699*: A, inrolled outline without keel (k) and associated parenchyma, × 100; B, vascular bundle and mesophyll arrangement and chlorenchyma cell detail, × 400. C, D, *Ellis 4697*: C, outline with undifferentiated keel (k) and tapering margin, × 100; D, chlorenchyma cell detail showing slight cell wall invaginations, × 400. E, F, *Ellis 618*: E, outline showing median vascular bundle without associated parenchyma tissue (k), × 100; F, compact chlorenchyma cells with slight wall indentations, × 400.

hairs and stomata (Figure 10D) are typical of those of the Ramosa group.

Specimens examined

CAPE.—3219 (Wuppertal): Clanwilliam Dist., Pakhuis Pass (–AA), *Ellis 4634* (culm only). 3318 (Cape Town): Jonkershoek State Forest, Jakkalsvlei (–DD), *Ellis 2235* (reduced blades present). 3418 (Simonstown): Hottentot Hollands Mts, Sir Lowry's Pass (–BB), *Ellis 4673* (few, reduced blades).

E. rehmannii

Although this species is characterized by herbaceous culms and blade-bearing leaves, several anatomical voucher specimens have suffrutescent culms and reduced, caducous blades. Examples are *Ellis 648* which is morphologically intermediate between subsp. *rehmannii* and *E. ramosa* subsp. *aphylla* and *Ellis 1295* and *4660* which are morphologically intermediate between subsp. *filiformis* and subsp. *subspicata*. However, no anatomical intermediacy is evident in these specimens, making their interpretation difficult.

No clear anatomical discontinuities exist between any of the three subspecies of *E. rehmannii* or with *E. ramosa*. Instead there is a general trend from *E. ramosa* through *E. rehmannii* subsp. *rehmannii* to subsp. *filiformis* along which leaf thickness decreases, the margins tend to become more tapered and the prickles become smaller and fewer in number. Several exceptions to this pattern exist, so the trend may represent an ecological gradient rather than a phylogenetic lineage.

E. rehmannii subsp. *rehmannii*

All specimens have relatively thick mesophyll tissue displaying a tendency to the radiate condition (Figure 11B, D, F). The chlorenchyma cells are not isodiametric but more elongated with slight cell wall indentations. The leaf margin is more acute than in *E. ramosa* and may taper to a definite point (Figure 11C). The adaxial surface may be flat (Figure 11F) or ribbed (Figure 11B, D).

The epidermal structure is remarkably uniform throughout the sample (Figure 12A–D) with rectangular long cells being conspicuous. Only *Ellis 4697* (Figure 12C, D) has

a few intercostal hooks, these with very long barbs. All have a few costal prickles with short barbs. The silica bodies are variable in shape but generally are shorter dumbbell-shaped than in *E. ramosa*.

Ellis 4697 is noteworthy in that it differs in having a tapering margin (Figure 11C), has the thickest leaf with definite ribs (Figure 11D) and possesses intercostal prickles (Figure 12C). This deserves further comment as it was collected together with *Ellis 4698* and *4699* from an actively growing and spreading population recovering after a fire. The latter two specimens differ from *Ellis 4697* in having more abrupt margins, thinner blades (Figure 11A, B) and no prickles (Figure 12A). Thus, within a single population, considerable anatomical variation is evident, even in those characters which show a trend through this species group. This supports the decision not to attach any taxonomic importance to these anatomical differences.

Although anatomical differences may, therefore, not be reflected in the morphology, the reverse is also true. *Ellis 648* is morphologically intermediate between *E. rehmannii* subsp. *rehmannii* and *E. ramosa* subsp. *aphylla* but anatomically virtually identical to *Ellis 618*, subsp. *rehmannii*. Reference to Figures 11E, F; 12B and 13A–D illustrate this resemblance clearly, both specimens with distinctive thick, compact mesophyll and well developed bulliform groups, without adaxial ribs and without large prickles in the epidermis. These two specimens are more alike in leaf anatomy than they are to all the other specimens in the Ramosa group. It therefore appears that there is little or no congruence between leaf anatomy and morphology in this species group, a situation which differs from that in the other groups of *Ehrharta*.

Specimens examined

CAPE.—3320 (Montagu): Barrydale Dist., Tradouw's Pass (–DC), *Ellis 648* (intermediate between subsp. *rehmannii* and *E. ramosa* subsp. *aphylla*). 3322 (Oudtshoorn): Outeniqua Mts, Robinson's Pass (–CC), *Ellis 4697, 4698* and *4699*. 3323 (Willowmore): Groot River Pass between Plettenberg Bay and Storms River (–DC), *Ellis 618*.

E. rehmannii subsp. *filiformis*

This taxon is placed at one end of the continuum of anatomical variation and has the thinnest leaves, the most tapering margins and few, small prickles. The leaf blades are thin and inrolled from both margins (Figure 14A, C, E). The chlorenchyma beneath the bulliform cells is only two to four cells deep and no radiate tendency is evident (Figure 14B, D, F). The margins are also distinctly tapering (Figure 14A, C, E). The silica bodies are short dumbbell-shaped and the prickles are usually few in number and small and hook-like (Figure 14G, H). The stomata and microhairs are typical of those of the Ramosa species group (Figure 16H). The intercostal long cells are distinctly hexagonal in outline (Figure 14G, H), a feature not apparent in any other specimens.

This anatomy is consistent with the small, soft, thin leaf blades of this subspecies and the leaf anatomy is uniform throughout the study sample. The anatomy is also fairly

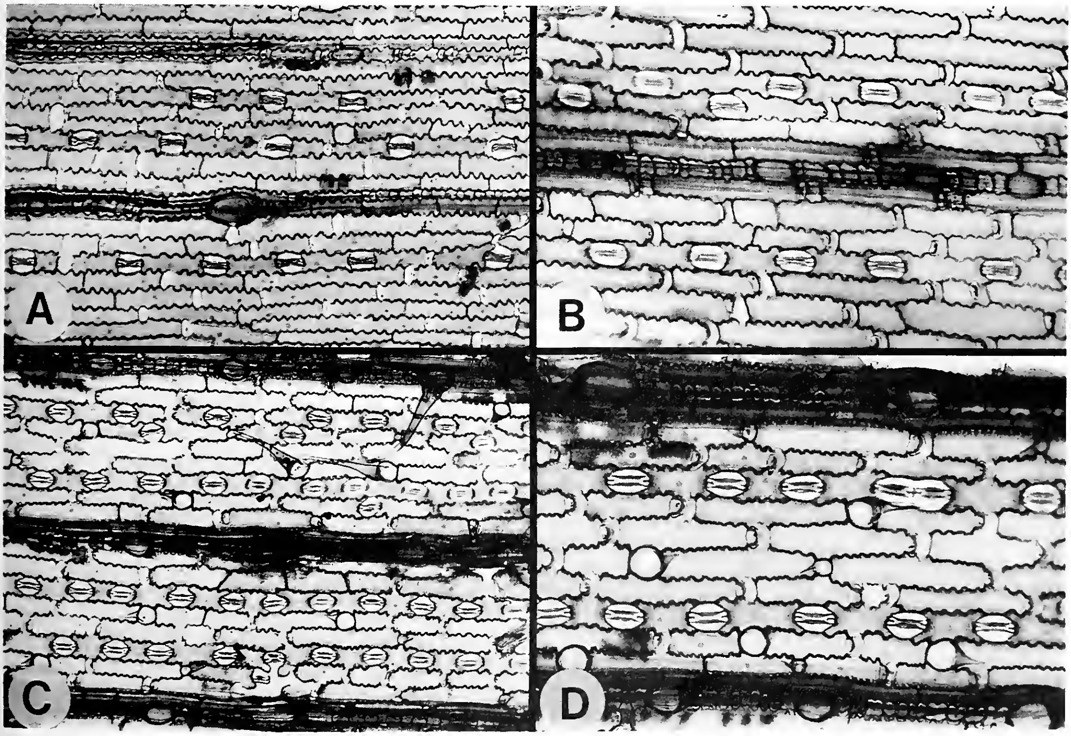

FIGURE 12.—Abaxial leaf blade epidermis of *Ehrharta rehmannii* subsp. *rehmannii*. A, *Ellis 4699*, with sinuous, rectangular intercostal long cells, stomata and costal prickles, × 250. B, *Ellis 618*, illustrating costal and intercostal cell detail and arrangement, × 400. C, D, *Ellis 4697*: C, showing costal and intercostal zone configuration and elongated prickle hairs, × 250; D, detail showing costal prickles and silica bodies and intercostal long cells, stomata and hooks, × 400.

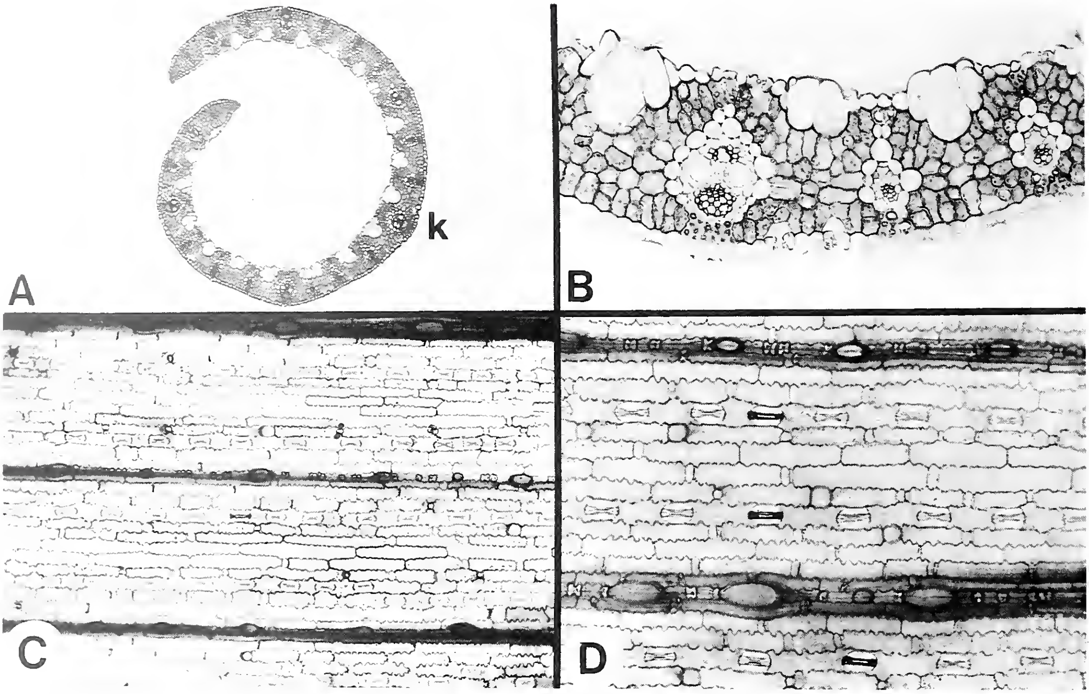

FIGURE 13.—Leaf anatomy of specimen morphologicallly intermediate between *Ehrharta rehmannii* subsp. *rehmannii* and *E. ramosa* subsp. *aphylla, Ellis 648*. A, B, leaf transverse sections: A, inrolled outline and median bundle without asociated parenchyma tissue, × 100; B, detail of chlorenchyma and vascular bundles, × 400. C, D, abaxial epidermis: C, epidermal zonation, × 250; D, elongated, rectangular intercostal long cells, dome-shaped stomatal subsidiaries, irregular silica bodies and costal prickles, × 400.

distinct from that of the other taxa in the Ramosa species group and subsp. *filiformis* appears to represent a more clear-cut entity than do the other taxa of the group.

Once again, intermediate specimens tend to confuse these patterns, in this case specimens intermediate between subsp. *filiformis* and subsp. *subspicata* from the limestones of the De Hoop area. *Ellis 1295* and *4660* both diverge considerably in both morphology and leaf anatomy from the rest of the sample representing this taxon (Figure 15A–F). The leaf blade of *Ellis 1295* has a tapering margin (Figure 15A), is very thin (Figure 15B), has hexagonal long cells, elongated dumbbell-shaped silica bodies and very numerous, conspicuous macrohair-like prickles (Figure 15C). This anatomy is distinct and does not closely resemble any other Ramosa species group specimen. *Ellis 4660* also has very distinctive anatomy, the leaf being very narrow (Figure 15D) with the tapering margins exaggerated into a pointed projection (Figure 15E). The abaxial epidermis of this specimen does not have macrohair-like prickles but has numerous normal prickles with short barbs (Figure 15F). Both these specimens differ greatly from all the others examined and also differ considerably from one another although they come from virtually the same locality.

These intermediate specimens from this specialized limestone habitat are abnormal in that they are woody and suffrutescent with very few leaves but they are small plants and their spikelets are similar in form to subsp. *subspicata* but fall within the size range of subsp. *filiformis*. They are retained in subsp. *filiformis* even though their leaf anatomy does not correspond closely to that of either subsp. *filiformis* or subsp. *subspicata*.

Specimens examined

CAPE.—3318 (Cape Town): Jonkershoek (–DD), *Ellis 4676*. 3418 (Simonstown): Hottentot Hollands Mts, Sir Lowry's Pass (–BB), *Ellis 2288, 2289*. 3419 (Caledon): Hermanus Dist., Olifantsberg (–AD), *Ellis 4671*. 3420 (Bredasdorp): between Malgas and Wydgelegen (–AD), *Ellis 1295, 4660* (intermediate to subsp. *subspicata*).

E. rehmannii subsp. *subspicata*

No authentic material of this subspecies was freshly collected in the field for this study. Consequently, comparative studies were not possible but herbarium material (*Taylor 7667*) was examined in order to gain an understanding of the anatomy of this taxon. Indications are that it belongs closest to *E. ramosa* along the trend which is evident in this species group. The leaf appears to be rather thick with abrupt margins but the epidermis is without numerous well developed prickles. This must be confirmed from freshly fixed material.

DISCUSSION AND CONCLUSIONS

The spikelet morphology and leaf anatomy of the five taxa of the Ramosa group is diagnostic and defines them as a group separate from the other species groups in *Ehrharta*. No spikelet characters are unique to the Ramosa group alone, but all taxa in the Ramosa group may be distinguished by the following combination of characters: small spikelets less than 9 mm long, with the sterile lemmas similar in shape and size and about as long as the fertile lemma, and having the bases appendaged and usually bearded, the sides glabrous, scabrous or shortly hairy and the tips rounded, truncate or mucronate. In addition, all species are perennial and may be suffrutescent, leaf

blades may be absent, glumes are two-thirds as long to longer than the lemmas and the upper sterile lemma is not stipitate.

Anatomically, the Ramosa group taxa share the following unique characters: mesophyll cells compact with slight cell wall invaginations, stomata dome-shaped with a rim surrounding the aperture and lacking associated wax deposits, and the microhairs with the distal cells not tapering. Other characters which together differentiate the group include: leaf blades (when present) inrolled, midrib lacking parenchyma, ribs and furrows absent or only slightly developed, costal and intercostal zones differentiated, intercostal long cells rectangular with sinuous walls, silica bodies tending to dumbbell shape; prickle hairs always present, varying from small and hook-like with short barbs to macrohair-like with elongated barbs, and epicuticular wax usually absent. Characters which are particularly consistent throughout the group are inrolled leaf blades and the midrib lacking parenchyma. Characters of ribs, chlorenchyma, silica bodies and prickle hairs tend to be more variable.

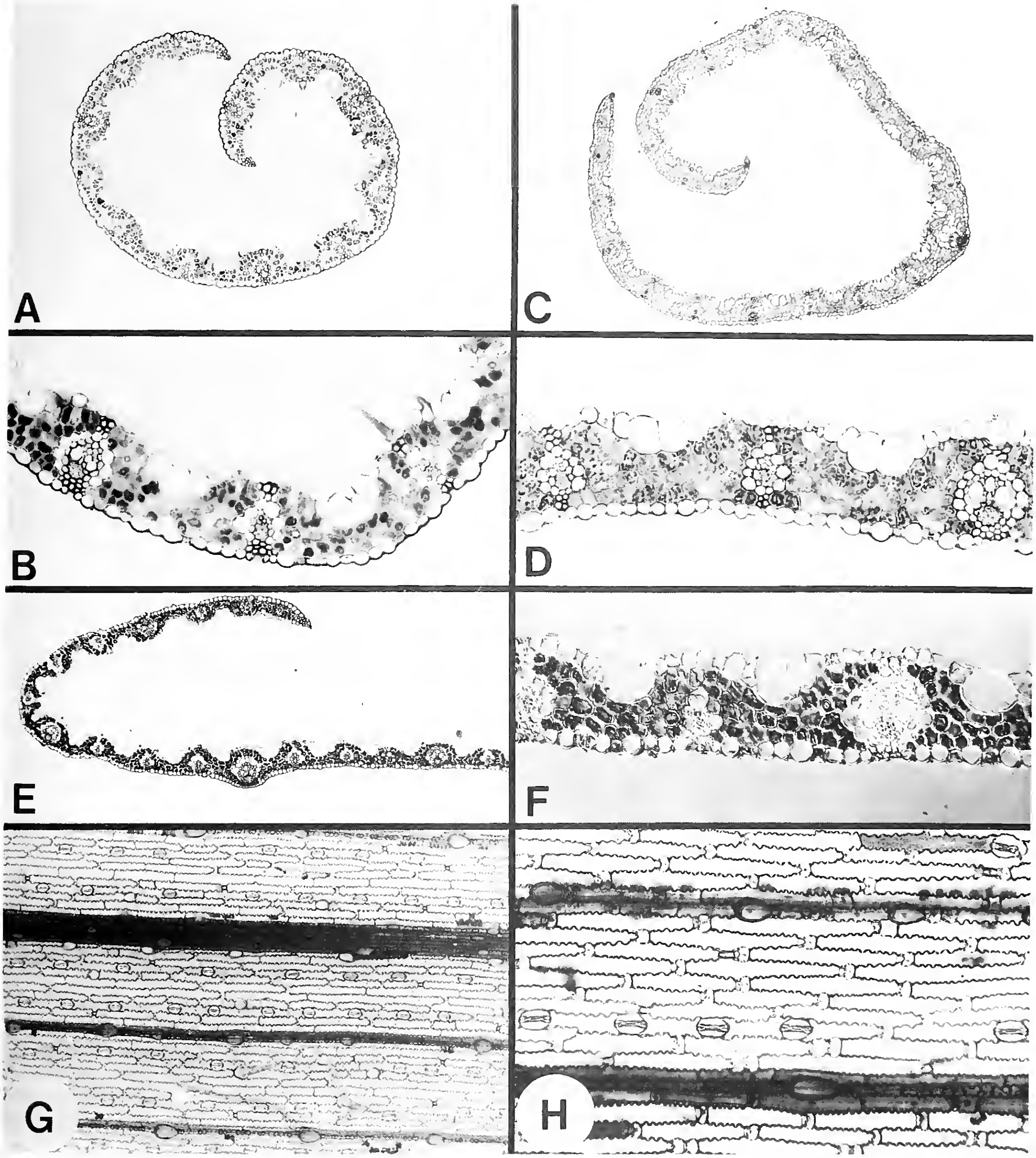

FIGURE 14.—Leaf blade anatomy of *Ehrharta rehmannii* subsp. *filiformis*. A–F, transectional anatomy: A, inrolled blade with tapering margins and median bundle only, × 100; B, chlorenchyma and vascular bundle structural detail and adaxial prickles, × 400; C, loosely inrolled outline without keel and with tapering margins, × 100; D, vascular bundle and mesophyll structure and arrangement, × 400; E, leaf blade outline showing inrolled margin and median bundle only, × 100; F, thin mesophyll layer but cells with slight wall indentations, × 400, interference contrast. G–H, abaxial epidermis: G, showing epidermal zonation and prickle hairs, × 160; H, with fusiform long cells, stomata and costal prickles, × 400. A, B, *Ellis 2288*; C, D, *Ellis 2289*; E, F, H, *Ellis 4676*; G, *Ellis 4671*.

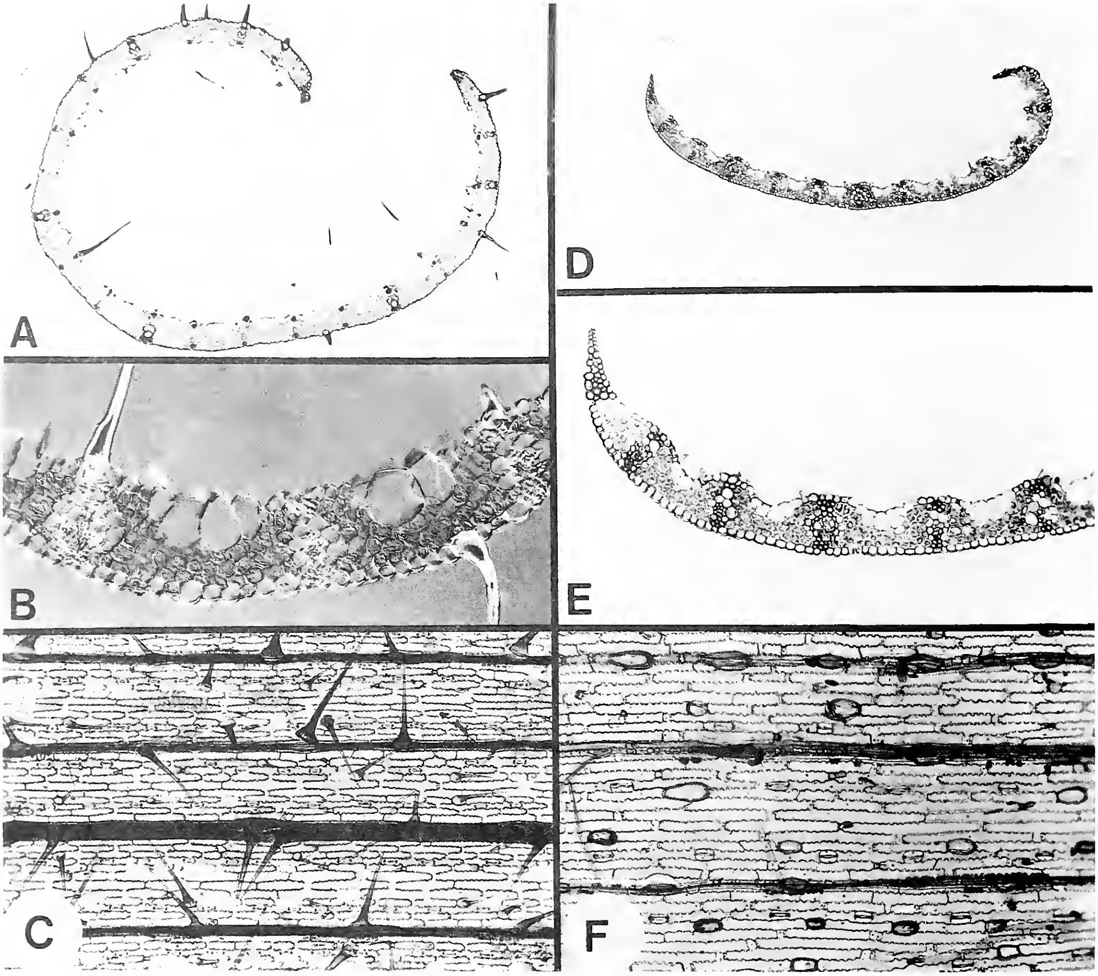

FIGURE 15.—Leaf anatomy of specimens intermediate btween *Ehrharta rehmannii* subsp. *filiformis* and subsp. *subspicata*. A–C, *Ellis 1295*: A, leaf outline showing thin inrolled lamina with prominent prickles and without a keel, × 100; B, detail of abaxial and adaxial macro hair-like prickles and few chlorenchyma cell layers, × 400, interference contrast; C, costal and intercostal prickles which resemble macrohairs in surface view, × 160. D–F, *Ellis 4660*: D, outline showing narrow blade with undifferentiated keel and markedly tapering margins, × 100; E, detail of narrow projecting margin, × 250; F, abaxial epidermis showing elongated, rectangular long cells, and costal and intercostal prickles with short barbs, × 250.

The Ramosa group is most closely related to the Calycina group for both morphological and anatomical features. Auriculate appendages at the base of the second sterile lemma occur only in these two groups. Also, the truncate or tapering mucronate sterile lemma tips of both the *E. ramosa* subspecies are similar to those of *E. calycina*, and the hairs on the sides of the sterile lemmas in most specimens of *E. rehmannii* subsp. *rehmannii* tend toward the longer hairs on the lemma sides of all members of the Calycina group. The anatomical relationship between the two species groups is not so marked. The long cells of the Ramosa group are usually rectangular, but a few specimens of *E. rehmannii* have fusiform long cells, an elongated hexagonal shape which is characteristic of the Calycina group.

Other characters show apparent similarities between the Ramosa group and other species groups, but closer examination shows that they are not closely related. Suffrutescent, bladeless species occur in both the Ramosa and Villosa groups: *E. ramosa* is similar in habit to *E. thunbergii* and *E. villosa* in the Villosa species group. While this might indicate a relationship between the groups, it is also possible that the bladeless suffrutescent condition, with photosynthetic culms that persist from year to year, is an adaptation to conserve plant parts in the low nutrient soils in the Mountain Fynbos and seaside dunes where these species occur.

The indentations in the walls of the chlorenchyma cells present in many of the specimens in the Ramosa group may be taken to resemble the invaginations characteristic of arm cells. Engelbrecht (1956) reported arm cell-like invaginations in representatives of the Ramosa group (*E. ramosa, E. rehmannii* and *E. subspicata*) based on preparations from herbarium material. However, the present study does not confirm Engelbrecht's observations because closer examination of well preserved young leaf material shows that these structures are not inward projections of cell walls but merely the wavy outlines of these walls.

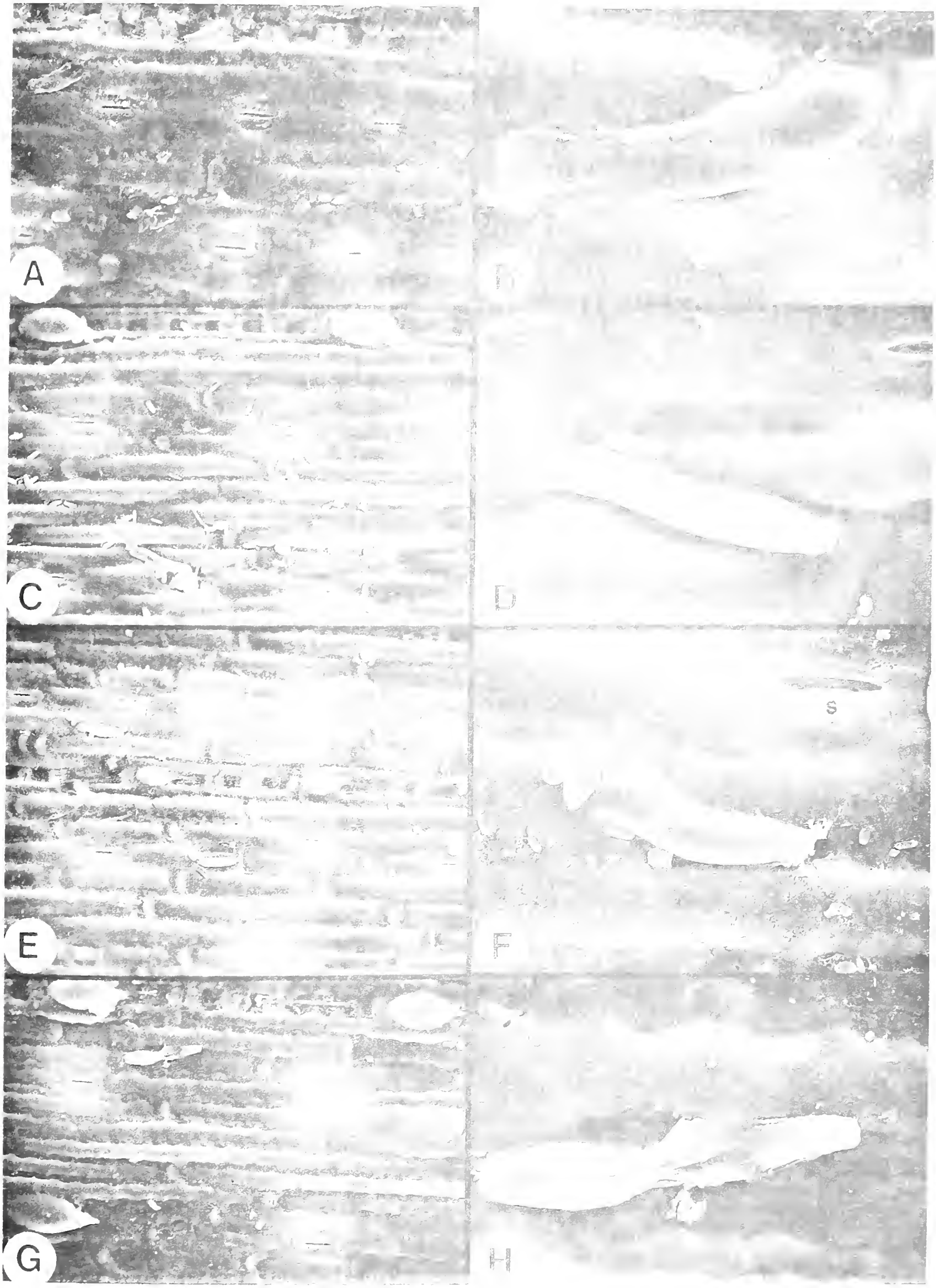

FIGURE 16.—Abaxial epidermal ultrastructure of *Ehrharta rehmannii*. A–F, *E. rehmannii* subsp. *rehmannii*: A, rectangular long cells, stomata with rims and dumbbell-shaped silica bodies, × 200; B, detail of bicellular microhair without tapering distal cell, × 1 000; C, elongated, rectangular long cells and costal prickles, × 200; D, microhair with distal cell not acutely tapering, × 1 000; E, rectangular long cells with brickwork type of arrangement and small costal prickles, × 200; F, microhair with intact distal cell and stoma with distinct rim (s), × 1 000. *E. rehmannii* subsp. *filiformis*: G, long cells elongate rectangular with thick, sinuous anticlinal walls, stomata with rims and prickles with short barbs, × 200; H, detail of microhair with collapsed but truncated distal cell and thickened, sinuous anticlinal walls of long cells, × 1 000. A, B: *Ellis 4697*; C, D: *Ellis 4693*; E, F: *Ellis 4699*; G, H: *Ellis 4671*.

Nevertheless, these loose folds of the walls are unique to and diagnostic for the Ramosa group. They do not appear to be homologous with arm cells and therefore do not indicate affinities with the Setacea group or with the Bambusoideae.

Individual specimens from the far north-western distribution limit of the Ramosa Group also show inter-group relationships. A population from Van Rhyn's Pass in the Bokkeveld Mountains shows the spikelet shape and hairiness of *E. calycina*, but the plants are suffrutescent, growing in bushy clumps similar to *E. rehmannii* (*Ellis 1147, 4625, Gibbs Russell 5588*). The anatomy of these specimens resembles that of the Ramosa group, with inrolled blades, absence of a midrib and ribs, compact mesophyll and numerous prickles. However, the stomata are not of the Ramosa type and the silica bodies are not dumbbell-shaped. The microhairs appear to be intermediate, being narrower than the Ramosa type but not tapering to a point as in the Calycina group. Long cell shape is variable, with some specimens having rectangular Ramosa-type cells and others showing fusiform Calycina-type cells. Specimens of this population appear to establish a clear morphological and anatomical link between these two species groups and possibly represent a hybrid between them.

A single specimen (*Ellis 5511*) from Sneeukop Peak in the Cedarberg area probably represents a new species. It has the open inflorescence, long glumes and appendaged mucronate glabrous sterile lemmas of *E. ramosa* subsp. *aphylla*, but its culms are herbaceous and the base of the plant is extraordinarily leafy, with long erect blades similar in number and position to those of *E. dura*, but with leaf anatomy similar to *E. capensis*. Its correct species group is therefore presently unknown.

Apart from this single specimen, the Ramosa group shows affinities only with the Calycina group, otherwise occupying an isolated position within the genus. The anatomy of the group is distinct, with several unique features.

The imprecision of defining the taxa in the Ramosa group is in contrast to other species groups (e.g. Villosa, Dura, Capensis) where the species and infraspecific taxa are more easily delineated. There are two sources of doubt in identifying specimens in the Ramosa group: first, many intermediates for both morphological or anatomical characters have been recorded (Figure 17); second, some of the most useful characters for separating taxa depend on character states that may vary during the life cycle of an individual. It is particularly difficult to distinguish an open inflorescence from a contracted one early in the flowering season, and it appears from field observations that plants which become suffrutescent and bladeless when mature may be herbaceous and conspicuously leafy when young. Long-term phenological studies related to fire frequency are necessary to understand the true relationship between the infraspecific taxa in the Ramosa group.

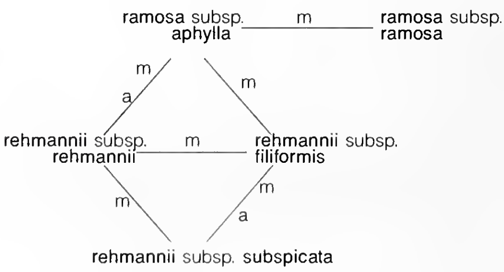

FIGURE 17.—The occurrence of intermediates between subspecies in the Ramosa group is shown by a line between taxa. The symbol 'm' indicates morphological intermediates and the symbol 'a' indicates anatomical intermediates.

ACKNOWLEDGEMENTS

The following herbaria are thanked for the now long-standing loans of *Ehrharta* specimens: BOL, J, JF, NBG & SAM, STE. Specimens from K, P and LE were examined at Kew. We thank the Keeper, Mr G. Lucas, and Deputy Keeper, Dr W.D. Clayton, for visitor's facilities and especially for the generous gift of many colour photographs of specimens; the Director of B for visitor's facilities; A. Romanowski for photography, S. Perold for scanning electron microscopy, G. Condy for the spikelet drawing and H. Ebertson, A. Botha and W. Roux for technical assistance.

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Acocks 19908 (1a) K, PRE; *21178* (2c) PRE; *22484* (2b) K, PRE; *24130* (2b/2c) K, PRE; *Acocks & Hafstrom 13.11.1938* (1b) PRE. *Adamson 597* (1b) PRE; *675* (2b) PRE; *1250* (1b) BOL; *1253* (2b) BOL; *2427* (2b) BOL; *2696* (2c) BOL; *2734* (1b) BOL; *3701* (2c) BOL, PRE; *3969* (1b) JF. *Andreae 30* (1b) PRE; *705* (1a/1b) PRE; *1298* (1a) PRE. *Archibald 3480* (1a) BOL, PRE.

Balkema 48 (1b) STE. *Barnard* (1a) SAM (No. 28386). *F. Bolus Nov. 1913* (1b) PRE; *Oct. 1913* (2b) NBG; *Jan. 1913* (2b) PRE; *Nov. 1913* (2b) K, PRE; *Dec. 1913* (2b) PRE; *Dec. 1915* (2b) BOL; *Jan. 1915* (2b) BOL, K. *H. Bolus 4733* (1b) BOL; *14670* (1b) K; *14740* (2) K. *Bond 1613* (2a) PRE; *s.n.* (2a) NBG. *Boshoff P302* (1a) STE. *Boucher 1456* (2b) JF, STE; *1661* (1b) JF, PRE, STE; *1724* (1b) PRE, STE; *2380* (1b) PRE, STE; *2646* (2b) STE; *4202* (1a) PRE, STE. *Burchell 543* (1b) K, PRE; *4648* (1a) K; *5974* (2) K; *6712* (2) K, PRE (fragment). *7011* (1a) K; *7312* (1a) K; *7725* (1b) K, PRE (photo and fragment). *Burtt Davy 15121* (1a) K.

Carmichael s.n. (1b) PRE. *Cleghorn 2020* (2c) PRE; *2491* (2c) K, PRE; *2498* (2) K; *3103* (2c) PRE, STE; *3143* (2b) K, PRE, STE; *3164* (1b) STE, PRE. *Compton 8245* (2b) NBG; *12870* (1a) BOL, NBG; *16962* (2b) NBG; *18595* (1b) NBG; *20228* (1b) NBG; *23076* (2a) K, NBG. *Crook 1021* (1b) K, BOL, NBG, PRE; *1035* (2b) BOL, K, NBG, PRE.

Dahlstrand 2970 (1a) J, PRE, STE. *Durand 299* (1a) JF. *Drège* (1a) SAM (No. 19639); *Du Toit's Kloof* (1a) K; *Giftberg* (1b) K; *Paarl Mts* (1b) K; *Table Mtn* (1b) K; *s.n.* (1a) P. *Du Toit 1345* (1b) PRE, STE; *1425* (1b/2a) PRE, STE; *1747* (1a/2a) STE.

Ecklon 914 (in part) (1b) K; *914* (in part) (2b) K; *s.n.* (1a) P. *Ecklon & Zeyher s.n.* (1a) B. *Ellis 618* (2a) PRE; *634* (1a) PRE; *648* (1b/2a) PRE; *1295* (2b/2c) PRE; *1632* (1a) PRE; *2235* (1b) PRE; *2288* (2b) PRE; *2289* (2b) PRE; *4634* (1b) PRE; *4660* (2b/2c) PRE; *4671* (2b) PRE; *4673* (1b) PRE; *4676* (2b) PRE; *4694* (1a) PRE; *4697* (2a) PRE; *4698* (2a) PRE; *4699* (2a) PRE; *5511* (?) PRE; *5525* (1a) PRE. *Esterhuysen 580* (2b) PRE; *632* (1b) NBG; *3930* (1a/1b) BOL; *6690* (1a) K, BOL, PRE; *6751* (2a) BOL, K, NBG, PRE; *8343* (1a) K, BOL, NBG, PRE; *8605* (1b) BOL; *9840* (1a) BOL; *10607* (2a) BOL, PRE; *10815* (1a) PRE; *11317* (1a) PRE. *11785* (1b) PRE; *11786* (2b) PRE; *11787* (2b) BOL; *12348* (1b) BOL, PRE; *13505* (1b) BOL, PRE; *13581* (2a) BOL, NBG, PRE; *14978* (1a/1b) NBG; *27314* (2a) BOL, PRE; *27426* (1a) PRE; *28011* (1a) BOL, PRE; *28110* (1b/2b) BOL, PRE; *28396* (1b/2b) BOL, NBG, PRE; *28651* (2b) BOL, PRE; *32217* (1a/1b) BOL; *32499* (1b) BOL; *33393* (2b) BOL, PRE; *33720* (2c) BOL, K, PRE; *34075* (2c) BOL; *34468* (2c) BOL; *35541* (2b) BOL, K; *35856* (1a) BOL.

Fairale 284 (2c) PRE; *286* (1b) PRE; *297* (2c) PRE. *Forsyth 354* (1b) JF. *Fourcade 921* (2a) BOL; *1589* (2a) BOL; *2478* (1a) BOL, PRE; *2815* (2a) BOL, K, PRE, STE; *4259* (1a) K, STE; *5529* (2a) STE; *6496* (1a) BOL, STE; *s.n.* STE. *Fries, Norlindh & Weimarck 611* (1a) PRE.

Galpin 149 (1a) STE; *165* (1a) K, PRE, STE. *Geldenhuys 286* (2a) PRE. *Gericke 18.8.1950* (2c) PRE; *s.n.* (2a) PRE. *Gibbs Russell 5602* (1b) PRE; *5633* (1a) PRE; *5644* (2b/2c) PRE; *5646* (2b/2c) PRE; *5651* (2b) PRE; *5654* (2b) PRE; *5657* (1b) PRE; *5659* (2b) PRE; *5660* (1b) PRE; *5662* (1b) PRE; *5664* (2b) PRE; *5668* (1b/2a) PRE; *5672* (1b/2a) PRE; *5674* (1a/1b) PRE; *5679* (1a) PRE; *5683* (1a/2a) PRE; *5687* (1a) PRE; *5688* (1a) PRE; *5695* (2a) PRE; *5697* (2a) PRE; *5698* (1a) PRE; *5699* (1a) PRE. *Gluckman 11.10.38* (1b) J. *Grobler 31.10.62* (2b) K, STE.

Hanekom 1294 (1b/2a) K, PRE; *2045* (1a) PRE. *Harvey 318* (2) K; *329* (2b) K; *335* (2b) K. *Haynes H460* (1b) JF, K, PRE, STE; *596* (2b) JF, PRE; *597* (1b) JF, PRE. *Henderson 1278* (1b) NBG. *Howes 202* (1b) K.

Jacot Guillarmod 8478 (2a) K, PRE.

Kensit Nov. 1913 (1b) K; *Jan. 1914* (1a/2a) BOL, PRE; *Jan. 1914* (2a) BOL; *s.n.* (1b) J. *Kerfoot & Haynes 8* (1b) JF. *Kruger 340* (1b) JF, PRE.

Laughton s.n. (2a) BOL (No. 22542); *Levyns 9816* (2b) BOL; *s.n.* (1b) BOL. *Liebenberg 3805* (2a) K; *3808* (2a) K; *4011* (2a) PRE; *4064* (1b) PRE, STE; *4308* (1a/1b) PRE; *4331* (1a/1b) K, STE; *5589* (1b) PRE, STE. *8358* (2a) PRE. *Loubser 3219* (2b) STE. *Loxton 221* (1a/1b) PRE.

MacGillivray 392 (1b) K. *MacOwan 1692* (1b) K, SAM. *McCallum Webster N59a* (1b) K. *Marloth 3051* (1a) PRE, STE; *3062* (1b) PRE; *3065* (1b) PRE, STE; *3074* (1a) PRE. *Meebold 13862* (1b) PRE; *13864* (1b) PRE. *Moss 7641* (1b) J. *Muir 3802* (1a) PRE. *Mund & Maire* (1a) K, PRE (photo).

Ofsowitz 29 (2a) PRE.

Page Feb. 1918 (1b/2a) BOL. *Palmer s.n.* (2a) K, PRE. *Parker 4035* (2b) K, NBG, PRE; *4681* (1b) BOL, K, NBG, PRE; *4931* (2c) BOL, K, NBG, SAM. *Pearson 3222* (1b) K, J; *3533* (1b) K; *5133* (1a) BOL, K. *Phillips 49* (1a) NBG; *1382* (1b) SAM; *1686* (1a) SAM; *s.n.* NBG. *Pocock S123* (1a) PRE. *Prior Sept. 1846* (1b) K, SAM; *Apr. 1903* (2a) K.

Rehm 267 (1b) B, K; *s.n.* (2b) B. *Rehmann 74* (1a) K, PRE (photo and fragment). *Richardson 63* (1b/2a) JF. *Ronassen Dec. 1943* (1b) NBG. *Rycroft 14.12.1945* (2b) JF.

Salter 9648 (2b) BOL; *9665* (1b/2a) BOL, PRE. *Sandwith 51* (1b) K; *128* (1b) K, PRE. *Scharf 1050* (1a) K, PRE; *1594* (1a) PRE; *1705* (1a) PRE. *Schlechter 7285* (2b) BOL, P, PRE; *9180* (1b) BOL, K, P, PRE; *9417* (2b) BOL, K, P, PRE; *9873* (1a) K, BOL, PRE. *Smook 3697* (1b) PRE; *4083* (2a) K, PRE. *Stokoe 2652* (1b/2b) BOL, SAM (No. 49380, No. 67676); *7809* (1a/1b) BOL; *7811* (2b) BOL, SAM (No. 67673, 67674); *8639* (1b) K; *SAM No. 54502* (1a/1b) SAM. *Story 2389* (1a) PRE.

Taylor 3636 (2b) PRE, STE; *4235* (1a) PRE, STE; *4502* (2b) PRE, STE; *4590* (2b) STE, PRE; *5223* (1b) K, PRE, STE; *7667* (2c) PRE. *The Forester 8266* (1a/1b) PRE. *Thompson 2253* (1a) PRE, STE.

Van Daalen 137 (2a) PRE. *Van der Merwe 26-02* (1b) STE; *936* (1b) PRE, STE; *1794* (1b) STE; *2106* (1b) STE. *Van Rensburg 11* (1b) STE; *212* (1b) PRE, STE; *214* (2b) K, PRE, STE. *Van Wyk, Fellingham & O'Callaghan 432* (1a) STE. *Von Breitenbach 60* (2a/2c) PRE.

Wells 3236 (1a) PRE. *Williams 3152* (2b) K, PRE. *Wolley Dod 2385* (2b) K; *3118* (2b) BOL; *3121* (2b) BOL; *3477* (2b) BOL, K, PRE; *3519* (2c) BOL, K, PRE (photo and fragment). *Wright s.n.* (1b) K.

Zeyher 85 (1b) BOL; *293* (1a) BOL, NBG, PRE, SAM, STE. *4510* (1a) BOL; *4511* (1a) PRE; *4571* (1b) SAM; *Oct. 1830* (1a) PRE; *s.n.* (1a) BOL, P; (1b) SAM (No. 40069). *Zinn Feb. 1940* (1b) SAM.

Note that specimens from B, K, LE and P are not included on the distribution maps.

Bothalia 19,2: 209–215 (1989)

Notes on African plants

VARIOUS AUTHORS

ACANTHACEAE

SIPHONOGLOSSA AND *AULOJUSTICIA* IN SOUTHERN AFRICA

The genera *Siphonoglossa* Oerst. and *Aulojusticia* Lindau were recently revised for the southern African region. As a result it is necessary to describe a new species and make two new combinations. *Aulojusticia* is sunk under *Siphonoglossa* which is now represented in southern Africa by three species which are keyed out below. It should be noted that corolla lengths are measured from the base of the tube to the apex of the upper lip throughout.

Key to species

1a Corolla (35–)40–58 mm long; leaves 2–6 mm broad; restricted to Barberton area .... 3. *S. linifolia*
1b Corolla 13–35(–45) mm long; leaves usually broader than 6 mm; Natal, Transkei, eastern and southern Cape:
2a Corolla 34–45 mm long, lower lip 0,5–0,6 times as long as tube .... 2. *S. nkandlaensis*
2b Corolla 13–31 mm long, lower lip 0,2–1,2 times as long as tube .... 1. *S. leptantha*

1. **Siphonoglossa leptantha** *(Nees) Immelman*, comb. nov. Type: Cape, 3326 (Grahamstown): Uitenhage, Olifantshoek, by Boesmans River (–C or –D), *Ecklon s.n.* (S, lecto.!).

Gendarussa leptantha Nees in Linnaea 15: 372 (1841). *Adhatoda leptantha* (Nees) Nees: 390 (1847). *Justicia leptantha* (Nees) Lindau: 349 (1893).

Two subspecies are recognized:

Corolla 13–22 mm long, lower lip (0,3–)0,6–1,2 times as long as the tube, tube 1,5–2 mm in diameter; Knysna-Tsitsikamma area, rarely as far east as Grahamstown .... 1b. *S. leptantha* subsp. *late-ovata*
Corolla 15–31 mm long, lower lip 0,2–0,5 times as long as the tube, tube 0,5–1,5 mm in diameter; from Grahamstown through the Transkei to Ngoye Forest (Natal) .... 1a. *S. leptantha* subsp. *leptantha*

1a. subsp. **leptantha**

Adhatoda tubulosa Nees: 392 (1847). *Justicia tubulosa* (Nees) T. Anders.: 41 (1864). *Siphonoglossa tubulosa* (Nees) Benth. ex Lindau: 38 (1893); Benth. in Benth. & Hook. f.: 1110 (1896); Clarke in Thiselton-Dyer: 74 (1901). Syntypes: Natal, 3129 (Port St Johns): Umzimvubu, 500 ft. (–CB), *Drège s.n.* (G–DC, microfiche in PRE!); S. Africa (Olifantshoek?), *Ecklon & Zeyher s.n.* (MEL!).

Siphonoglossa nummularia S. Moore: 40 (1880); C.B. Cl. in Thiselton-Dyer: 75 (1901). Type: Cape, 3227 (Stutterheim): Keiskamma Hoek (–CA), *Cooper 370* (not found).

1b. subsp. **late-ovata** *(C.B. Cl.) Immelman*, comb. nov. Types: Cape, 3325 (Port Elizabeth): on the rocks of Swartwaterpoort (–BB), *Burchell 3405* (K, lecto.!, here designated); *Burchell 3364* (K!).

Justicia pulegioides subsp. *late-ovata* C.B. Cl. in Thiselton-Dyer, Fl. Cap. 5,1: 62 (1901).

In the length of the corolla tube this subspecies resembles *Justicia*, but it has the pollen and non-recurving stamens of *Siphonoglossa* (Table 1).

2. **Siphonoglossa nkandlaensis** *Immelman*, sp. nov., *S. leptantha* subsp. *leptantha* affinis, sed floribus longioribus distributioque differt.

Herba perennis; rami costati, nodis incrassatis. *Folia* lanceolata vel ovata, 33–44 × 15–20 mm, venae paginae inferae et margo pilis indutae, apex extensus obtusus, basis cuneata; petioli graciles, 6–17 mm longi, hirsuti. *Inflorescentiae* cymis remotis axillaribus compositae. *Bracteae* foliis similes sed minores. *Calyx* lobis anguste lanceolatis acuminatis hirsutis. *Corolla* (tubus et labium superum) 34–45 mm longa, purpurea vel flavovirens, labium inferum 0,6–0,6-plo longitudo tubi; stigma bilobatum. *Antherae* thecis elongatis angustatis, ad altitudines dissimiles insertis, uterque breve mucronatis; pollen bicolporatum, lenticulare, exino reticulato, area laevi utrinque colpi areolis elevatis triseriatis. *Capsulam* non vidi.

TYPE.—Natal, 2831 (Nkandla): Nkandla (–CD), *Wood 9000* (NH, holo.!).

Perennial herb, branches ribbed, swollen at nodes. *Leaves* lanceolate to ovate, 33–44 × 15–20 mm, hairs present along veins of undersurface and on margin, apex drawn out into a long blunt tip, base cuneate; petiole slender, 6–17 mm long, hirsute. *Inflorescence* of axillary cymes. *Bracts* similar to leaves but smaller. *Calyx* lobes narrowly lanceolate, acuminate, hirsute. *Corolla* 34–45 mm long (tube and upper lip), purple or yellow-green, lower lip 0,5–0,6 times as long as the tube; stigma bilobed. *Anther* thecae elongate, narrow, inserted at different

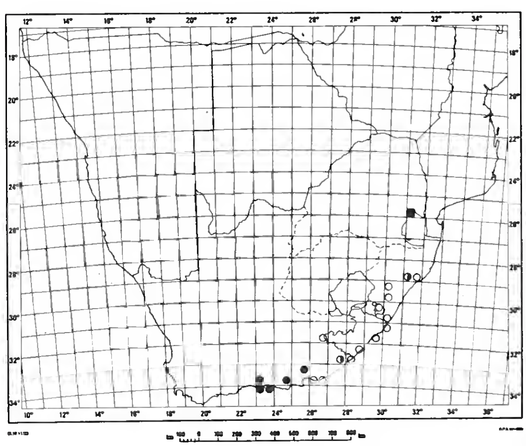

FIGURE 1.—Distribution of *Siphonoglossa* spp. in South Africa: *S. leptantha* subsp. *leptantha*, ○; *S. leptantha* subsp. *late-ovata*, ●; *S. nkandlaensis*, ◗; *S. linifolia*, ■.

TABLE 1.—Comparison of *Siphonoglossa linifolia* with other *Siphonoglossa* spp. and *Justicia* spp.

S. linifolia	*Siphonoglossa* (all other spp.)	*Justicia* (all spp.)
1. lower theca tailed	both thecae mucronate	lower theca tailed
2. pollen with 2–3 rows areoles	pollen with 2–3 rows areoles	pollen with 1–2 rows areoles
3. corolla tube long and narrow	corolla tube usually long and narrow	corolla tube usually short and broad
4. stamens not recurving with age	stamens not recurving with age	stamens recurving with age

heights, both shortly mucronate; pollen 2-colporate, lenticular, exine reticulate with the smooth area on either side of the colpi studded with 3 rows of raised areoles. *Capsule* not seen.

Five specimens of this species have been seen, two from the eastern Cape and three from Zululand (Figure 1). This distribution is similar to that of a species of the closely-related genus *Justicia* L., *J. capensis* Thunb., which also occurs in Zululand and the eastern Cape, but has never been recorded in the intervening areas of southern Natal and the Transkei. *S. nkandlaensis* is found associated with forest, either on its margin or along forest paths.

NATAL.—2831 (Nkandla): Nkandla Forest Reserve, in grassveld next to forest (–CA), *Venter 3486* (PRE); Nkandla, forest path (–CA), (in high forest near road, just before turnoff to Nkandla Forest Station—fide Wells pers. comm.), *Wells 2495* (PRE).

CAPE.—3227 (Stutterheim): Kei Bridge (–DB), *Schonland s.n.* (GRA); Komgha (–DB), *Flanagan 675* (GRA).

The very long flowers and the length of the lower lip relative to the tube distinguish this species from *S. leptantha* subsp. *leptantha*. The flowers are most similar to *S. linifolia* which, however, is quite different vegetatively, as well as in habitat and distribution.

3. **Siphonoglossa linifolia** *(Lindau) C.B. Cl.* in Thiselton-Dyer, Flora capensis 5,1: 75 (1901). Type: Transvaal, 2531 (Komatipoort): Barberton, Saddleback Mountain, 1 300–1 700 m (–CC), *Galpin 825* (B†; PRE, lecto.!, here designated).

Aulojusticia linifolia Lindau: 325 (1897); Lindau: 209 (1908).

Siphonoglossa linifolia, when originally described, had been placed in a monospecific genus, *Aulojusticia* Lindau. C.B. Clarke later removed the species to *Siphonoglossa*. After careful examination of the specimens in the major South African herbaria, the present author has decided to follow Clarke because no significant differences were noted in the pubescence of the corolla, in the stigma or in the pollen, all of which have at various times been used to distinguish the genera.

In some respects, e.g. leaves, habit, habitat and anthers, *Siphonoglossa linifolia* resembles *Justicia* rather than *Siphonoglossa*. However, the differences in leaves and habit are probably an adaptation to its more exposed habitat, and it was decided that *S. linifolia* would be better placed in *Siphonoglossa*. The similarities and differences considered significant are tabulated in Table 1.

This note is based on a thesis presented for the degree of Ph.D. at the University of Natal, Pietermaritzburg.

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POLYGONACEAE

OXYGONUM ALTISSIMUM, A NEW SPECIES FROM CENTRAL SOMALIA

Oxygonum altissimum *Germishuizen*, sp. nov. *O. buchananii* et *O. tristachyo* affinis, sed foliis ovatis valde minoribus, basin cuneatis, in petiolum longum decrescentibus, atque ocrea sine setis longis differt.

TYPE.—Central Somalia, 0346 (Aadan Yabaal District): 30 km S of Aadan Yabaal (–CA), *J.B. Gillett & J.J. Beckett 23264* (K, holo.; EA, MOG). Figure 2.

Slender, erect, much branched shrub, up to 3 m tall. *Branches* glabrous, covered with bloom; older branches grey or red, with bark peeling off in longitudinal flakes, revealing reddish wood beneath. *Ocreae* truncate, up to 10,0 mm long, membranous, white, glabrous, entire or with a few, short, brown, rigid setae on edge. *Leaves* simple, alternate, grey-green, smooth, covered with bloom, narrowly to broadly ovate, cuneate at base, acuminate at

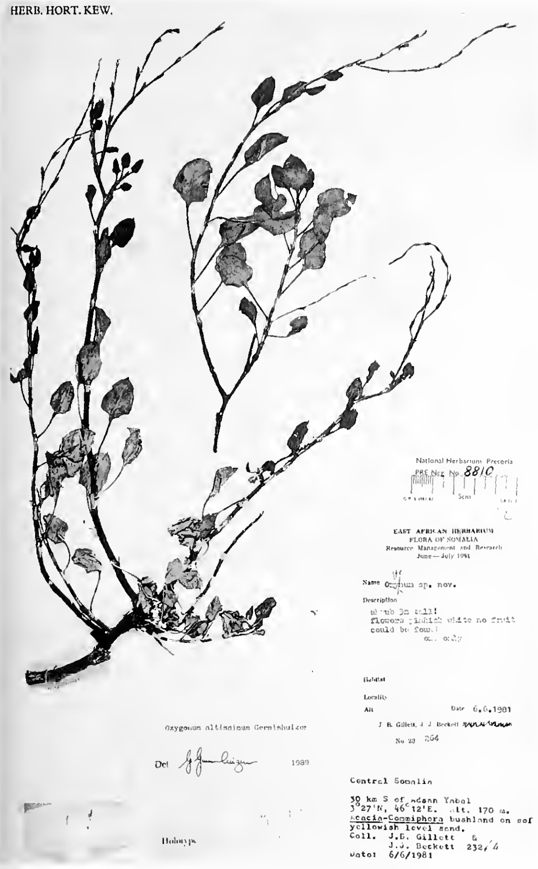

FIGURE 2.—*Oxygonum altissimum* Germishuizen, holotype.

apex, (13,0–)20,0–28,0 × 10,0–17,5 mm, entire or marginally pubescent with small, white scales, midrib ventrally visible, larger leaves towards stem base. *Inflorescence* a long lax thyrse with fascicles of up to 3 flowers in the axils of brown cuspidate membranous bracts; axis up to 110 mm long. *Perianth* 5-lobed, pinkish white; lobes oblong, up to 5 mm long. *Stamens* 8, included; filaments up to 5 mm long; anthers up to 1 mm long. *Styles* 3, up to 4 mm long, joined for two-thirds of the way; stigmas capitate. *Fruit* immature.

CENTRAL SOMALIA.—0346: 20 km WSW of Aadan Yabaal (–AC), *Kuchar 17291* (K; PRE); 30 km S of Aadan Yabaal (–CA), *Gillett & Beckett 23264* (EA; K; MOG).

Oxygonum altissimum is endemic to the sand plain area of Aadan Yabaal District of central Somalia. Found in soft yellowish orange, level sand in *Acacia-Commiphora-Loewia glandulosa* bushland. *O. altissimum* flowers during May and June. It is reported that the leaves of *O. altissimum* are untouched by stock, but occasionally eaten by camels when hungry.

The specific epithet *altissimum* is the Latin word meaning *the tallest*, and is used on recommendation of J.B. Gillett, an allusion to the tall habit these shrubs attain.

ACKNOWLEDGEMENTS

The author would like to thank the Director and staff (particularly J.B. Gillett) of Kew Herbarium for the loan of specimens and the opportunity to describe this new taxon. Dr H.F. Glen and A. Romanowski of the Botanical Research Institute, Pretoria are also thanked for their valuable assistance.

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POLYGONUM HYDROPIPER IN SOUTHERN AFRICA

During the course of a revision of the genera *Polygonum* L., *Bilderdykia* Dumort and *Reynoutria* Houtt. in southern Africa, it was found that numerous herbarium specimens filed under *Polygonum salicifolium* Willd. were wrongly identified.

In *P. salicifolium* the perianth is eglandular and pink to purple and the nut is always trigonous. In contrast, all the wrongly identified specimens under *P. salicifolium* had a green, glandular punctate perianth and a lenticular nut. Initially these specimens were thought to belong to a new taxon, but further studies showed that they belong to *P. hydropiper* L.

Studies were undertaken to establish whether other characters could be used to distinguish between the two taxa.

In all the investigated material it was found that *P. hydropiper* possesses a glandular perianth and lenticular fruit and *P. salicifolium* an eglandular perianth with a trigonous fruit (Figures 3 & 4). Only three other characteristics may be of some value in separating the two species. The fruit is no longer than 3 mm in *P. salicifolium* but always longer than 3 mm in *P. hydropiper* (Figures 3 & 4). The leaves of *P. salicifolium* are usually no wider than 2 mm whereas those of *P. hydropiper* are mostly broader than 2 mm (Figure 4). The width/length ratio of *P. salicifolium* is mostly less than 0,18 and that of *P. hydropiper* more than 0,19.

Polygonum hydropiper *L.*, Species plantarum 1: 361 (1753); Meisn.: 109 (1856); Benth. & F. Muell.: 269 (1870); Steward: 58 (1930); Webb & Chater: 79 (1964); Ohwi: 411 (1965); Lai: 271 (1976). Type: from Europe (collector and herbarium unknown).

Persicaria hydropiper (L.) Spach: 536 (1841); Britton & Brown: 670 (1913), Spach non Opiz.

Erect or basally decumbent slender annual, up to 1 m tall; stems simple or branched, glabrous. *Ocreae* tubular, membranous, brown, up to 20 mm long, thinly covered with close ascending, bristly hairs and terminally fringed with short erect-patent stiff bristles, 10,0–20,0 mm long (Figure 5B). *Leaves* subsessile; blade lanceolate, (50–)60–120(–150) × (5–)14–27(–32) mm, apically

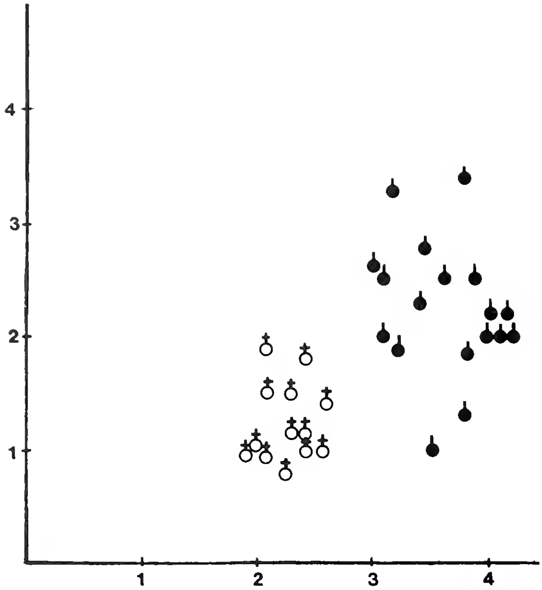

FIGURE 3.—A scatter diagram based on the width of the leaves in mm (X axis) and length of fruit in mm (Y axis) of *Polygonum salicifolium*, ♁; and *P. hydropiper*, ♦. ● = glandular perianth, ○ = eglandular perianth, ♦ = lenticular fruit, ♁ = trigonous fruit.

acute, cuneate at the base (Figure 5A), glandular-dotted on the lower surface, more or less scabrous at the margins. *Inflorescence* a slender terminal thyrse up to 120 mm long, often nodding at the ends of the stem branches. *Bracts* glabrous, truncate or truncate-rounded, reddish brown, with a terminal fringe of rigid bristles about 1 mm long. *Perianth* 4–5-lobed; lobes greenish white, 3–5 mm long (Figure 5C & D), brownish glandular-dotted. *Stamens* 5.

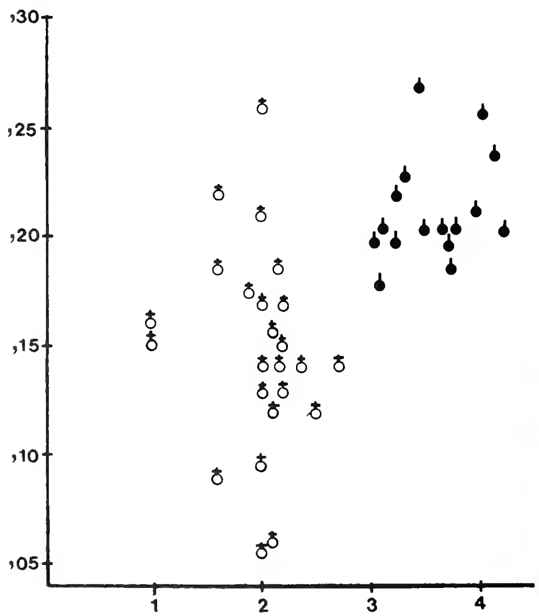

FIGURE 4.—A scatter diagram based on the width and length ratio of the leaves (X axis) and length of fruit in mm (Y axis) of *Polygonum salicifolium*, ♁ and *P. hydropiper*, ♦. ● = glandular perianth, ○ = eglandular perianth, ♦ = lenticular fruit, ♁ = trigonous fruit.

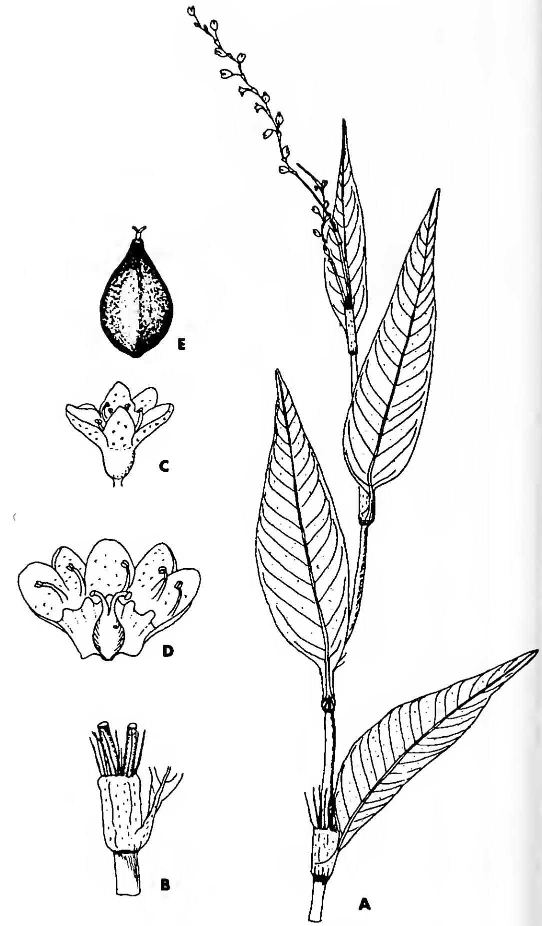

FIGURE 5.—*Polygonum hydropiper* L. A, habit, × 1; B, ocrea, × 1; C, flower, × 5; D, flower, longitudinal section, × 5; E, fruit, × 6.

Styles 2, united for half their length. *Nut* lenticular, dark brown, finely granulate, 3,0–4,5 mm long (Figure 5E).

A native of Europe, it is now widely distributed in the temperate and subtropical regions of the world. In southern

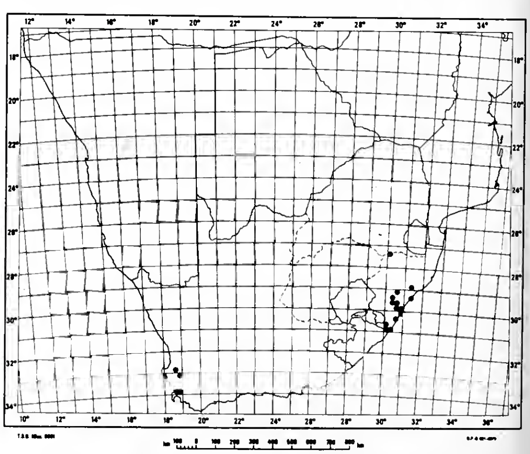

FIGURE 6.—Distribution of *Polygonum hydropiper* L.

Africa this species is found in the south-eastern Transvaal, Natal and south-western Cape Province (Figure 6). It occurs in damp places, often growing in water, and on stream and river banks and on the edge of dams.

The disjunct distribution may be attributed to the fact that seeds could have been transported to the main harbours of southern Africa, and spread from there. It flowers from December to April.

Voucher specimens: *Codd 6944* (PRE); *Esterhuysen 20155* (BOL); *Germishuizen 1640, 1858* (PRE); *Ward 5830* (NU, PRE).

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ARECACEAE

NEW BOTANICAL PERSPECTIVES ON THE ORIGIN OF THE *RAPHIA* PALMS AT MTUNZINI

The natural distribution of raphia palms in South Africa is limited to the Kosi Bay area in the extreme north-east of Zululand. However, early this century a grove of raphia palms was established at Mtunzini about 250 km further south on the Zululand coast (Figure 7).

There has been much speculation as to exactly when, why and how the first raphia palms were introduced to Mtunzini. Secondary sources, past and present, verbal and non-verbal, (Austen 1953; C.C. Foxon Jr pers. comm. 1987; Harrison 1986; Oberholster 1972; Palmer & Pitman 1972) differ somewhat with respect to the 'when' and 'why'.

The original supply of seed was in fact sent from Pretoria to Mtunzini by the then Secretary for Justice and Director of Prisons, Jacob de Villiers Roos (1916), who wrote to the magistrate at Mtunzini on the 21st July 1916, that it would be economical to grow the raphia palm in the marshy Government ground there, to supply the fibre for the Prison brush and broommaking industry, instead of importing it from West Africa via London.

This directive from Roos to C.C. Foxon, who was magistrate at Mtunzini from 1905 to 1921, clearly fixes the date and the reason for the establishment of raphia palms at Mtunzini. The origin of the seed supplied by Roos is not stated. However, on the 19th July 1916, A.M. Bottomley (1916) of the Division of Botany in Pretoria, wrote to Roos stating, 'I am forwarding you herewith the seed of Rafia (sic) vinifera which we obtained from Zululand'. It seems likely but not certain, that this was the seed, which, two days later, was forwarded to Foxon by Roos.

Two further parcels of raphia seed were sent to Foxon on behalf of the Director of Prisons, Pretoria, for planting. The covering letter (Director of Prisons 1917a) for the second batch, dated 10th January 1917, gives no indication whatever of the source of the seed.

It may also have been Zululand or perhaps Portuguese East Africa, but it is not unreasonable to consider the possibility that the seeds may even have come from West Africa, since raphia produce was imported from that source on a regular basis.

However, the covering letter (Director of Prisons 1917b) for the third (and apparently final) batch, dated 20th January 1917 states, 'I am forwarding under separate cover a consignment of the abovementioned seed (*R. vinifera*) which has been received from Portuguese East Africa'. This batch may have been *R. australis*, a species described only in 1969 (see discussion below) or *R. vinifera*, both of which occur in what is today Mozambique.

It is clear that in no single instance can the identity of the original batches of seed be established beyond reasonable doubt. Obviously, at least one batch must have contained *R. australis* in order to account for the existence of the present population at Mtunzini. At the time it was believed that all these seeds were of the species *R. vinifera*, but this was to be disproved later, as we shall see.

The raphia palms indigenous to northern Zululand and southern Mozambique are geographically isolated from other giant raphia palms in Africa. Despite this they were originally presumed to be of the species *R. vinifera* which occurs commonly in West Africa. An indication to the contrary was recorded when specific differences between the fruits of the Kosi Bay palms and those of *R. vinifera*, were noted by Aitken & Gale (1921), who concluded that 'either

FIGURE 7.—*Raphia* palms at Mtunzini, Zululand coast.

this palm is a variety of *R. vinifera*, or it may be a new species of the genus'. King (1925) also referred specifically to 'the true Raffia Palm', *R. vinifera*, and 'the giant palms from Kosi Bay', clearly believing them to be different species.

Much later, 1967, two palms at the Botanic Station in Durban, which were grown from seed collected at Mtunzini by Dr V.A. Wager, developed large (±3 m), erect inflorescences growing centrally above the crown of the leaves. It was then realized that a previously undescribed species was involved since, amongst others, the inflorescence of *R. vinifera* is pendulous. Obermeyer & Strey (1969) described the new species and named it *R. australis*. Despite the inclusion of 'Historical Notes' in their paper, Obermeyer & Strey make no reference to the observations of Aitken & Gale and King, whose earlier reports appear to have been overlooked.

The very uncertain identity of the original seed and the proven ease with which the true identity of established raphias may be overlooked, suggest the strong possibility that one or even more raphia species other than *R. australis* were also introduced to Mtunzini. Further support for this possibility is contained in a letter addressed to the Conservator of Forests, Pietermaritzburg, by King (1925), who stated that, 'The seeds supplied by Mr de V. Roos were of the true Raffia Palm. In addition to these certain seed of the giant palms from Kosi Bay was planted'. Yet today only *R. australis* is known to grow in the Mtunzini area. It could be speculated that the exotic species died out because they were less well adapted to local conditions.

The increase of *Raphia* trees in the immediate vicinity of Mtunzini was facilitated in the 1940's by L.E. Davis who collected seeds from the original grove and planted them while visiting the surrounding swamplands in the course of his duties as malaria control officer (Palgrave 1977; Wicht 1969).

In 1942 the original grove was declared a national monument (Government Gazette 1942). The grove is of no great historic significance and the procedures which led to the declaration were somewhat unorthodox. In spite of this, Mtunzini's raphia palms joined about 17 other botanical specimens which form about 5% of the list of the country's official national monuments (Oberholster 1972). The grove at the original site was virtually destroyed in 1948 when a spark from a passing locomotive set the trees ablaze (Oberholster 1972). The remaining trees were able to regenerate and a fine grove of palms may be seen at the site today.

Over the last three decades Mr Ian Garland has made a substantial contribution to the population of raphia palms by planting and distributing almost a thousand *R. australis* on, and in the vicinity of his farm 'Twin Streams', which borders Mtunzini (I.F. Garland pers. comm. 1987).

In recent years the Mtunzini Town Board has played an active role in promoting the raphia palm (Figure 7), which along with the closely associated palm nut vulture, *Gypohierax angolensis*, has been incorporated into the official town emblem (Government Gazette 1981).

Even though it is doubtful whether the exact origin of Mtunzini's raphia palms will ever be known their present status is secure and improving.

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Leaf anatomy of the South African Danthonieae (Poaceae): XIX. The genus *Prionanthium*

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Keywords: Arundineae, leaf anatomy, linear glands, Poaceae, *Prionanthium*, taxonomy

ABSTRACT

The leaf blade anatomy of *Prionanthium dentatum* (L. f.) Henr., *P. ecklonii* (Nees) Stapf and *P. pholiuroides* Stapf is described and illustrated. The transectional anatomy is non-Kranz with diffuse chlorenchyma. The adaxial epidermis has dome-shaped stomata, dumbbell-shaped to nodular silica bodies and elongated microhairs. The three species differ in the presence or absence of macrohairs, abaxial stomata and marginal linear, sessile glands. The latter character is shared with *Pentaschistis triseta* (Thunb.) Stapf and its allies, and relationships with *Pentaschistis* are indicated rather than with any other extant arundinoid genus.

UITTREKSEL

Die blaaranatomie van *Prionanthium dentatum* (L. f.) Henr., *P. ecklonii* (Nees) Stapf en *P. pholiuroides* Stapf word beskryf en geïllustreer. Die anatomie in dwarssnee is nie-Kranz met eweredig verspreide chlorenchiem. Die abaksiale epidermis het koepelvormige huidmondjies, murgbeenvormige silikaliggaampies en langwerpige, vingeragtige mikrohare. Die drie spesies verskil ten opsigte van die voorkoms van makrohare met geen gespesialiseerde basale epidermisselle, abaksiale huidmondjies en lineêre, steellose kliere op die blaarrand. Soortgelyke kliere kom ook by *Pentaschistis triseta* (Thunb.) Stapf en sy verwante spesies voor en verwantskappe met *Pentaschistis* word aangedui, eerder as met enige ander teenwoordigers van die tribus Arundineae.

INTRODUCTION

The genus *Prionanthium* is a small genus of three species all endemic to the south-western Cape Province. It includes small, ephemeral or annual plants which are exceedingly difficult to locate and are considered to be rare and/or endangered (Davidse 1988). Taxonomically the genus does not pose any particular difficulties and it contains three morphologically distinct species: *P. dentatum* (L. f.) Henr. (= *P. rigidum* Desv.), *P. ecklonii* (Nees) Stapf and *P. pholiuroides* Stapf. These three species are recognized by most previous workers (Chippindall 1955; Clayton & Renvoize 1986; Watson *et al.* 1986; Davidse 1988) although all these workers did not have access to material of all three taxa.

The recent revision by Davidse (1988) included all the anatomical voucher specimens used for the present study and the anatomical data reported on here is complementary to the morphology and cytology discussed in this revision. The present study is the first in which comparative leaf anatomy of all three species has been undertaken.

Although there is little difficulty with the delimitation of taxa within *Prionanthium*, the generic relationships of the genus are puzzling. Most authors now agree with the placement of the genus in the Arundinoideae, usually in the tribe Arundineae (= Danthonieae). Davidse (1988) convincingly argues the case for arundinoid relationships and, furthermore, demonstrates that *Prionanthium* and *Pentaschistis* are probably related. This conflicts with the suggestion of Clayton & Renvoize (1986) that the genus belongs with the primitive arundinoid genera such as *Tribolium, Urochlaena, Elytrophorus* and others from Australasia. The phylogenetic implications of the leaf anatomy of *Prionanthium* will be considered in this paper in order to shed more light on this problem. The purpose of this paper is, therefore, to describe and illustrate the leaf blade anatomy of *Prionanthium* and to compare this structure with that of the other South African danthonioid species, as well as with earlier published results for *Prionanthium.*

Little detailed attention has been given to the leaf anatomy of *Prionanthium* in the published literature but the information available does indicate typical arundinoid anatomy. The anatomy is non-Kranz with a double bundle sheath, non-radiate mesophyll with a maximum lateral cell count greater than four, bulliform cell groups not associated with colourless cells, finger-like microhairs with tapering distal cells, domed subsidiary cells and dumbbell-shaped to nodular silica bodies (Hansen & Potztal 1954; Renvoize 1986; Watson *et al.* 1986). Renvoize (1986) notes two unusual features for the subfamily: the chlorenchyma is not interrupted by sclerenchyma girders above and below the vascular bundles, and the epidermal cells are large and thin-walled. De Wet (1956) notes that the epidermis of *Prionanthium* is panicoid (with linear microhairs) but that the anatomy is festucoid with the chlorophyll tissue being uniformly distributed between the bundles.

MATERIALS AND METHODS

Specimens of all three species of *Prionanthium* were collected in the south-western Cape. Herbarium voucher specimens were prepared for verification by the staff of the National Herbarium (PRE) where they are housed.

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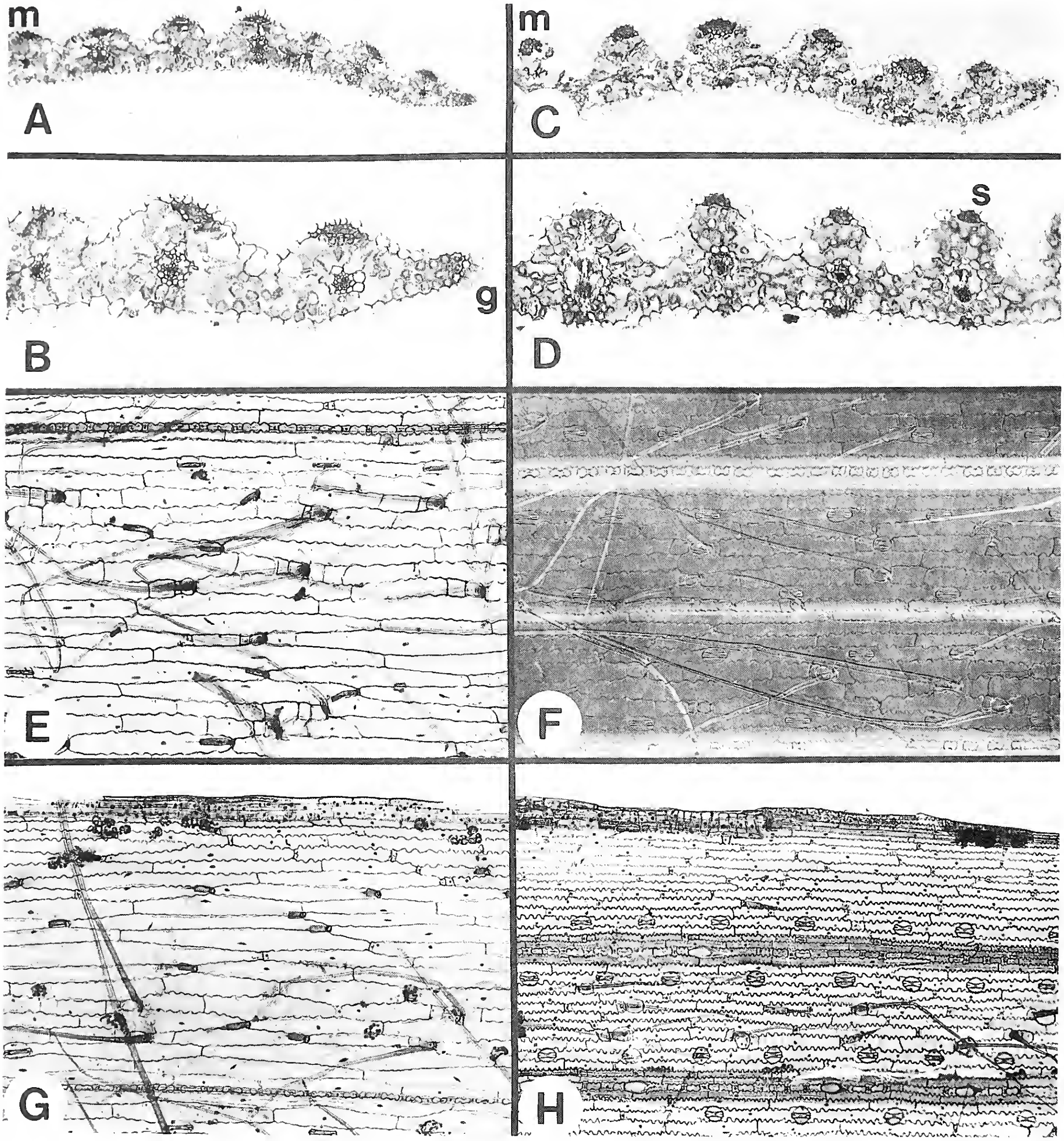

FIGURE 1.—Leaf blade anatomy of *Prionanthium dentatum*. A–D, leaf in transverse section: A, outline of lateral part of lamina showing undifferentiated midrib (m) and narrow, projecting margin, × 100; B, detail of margin showing sessile gland cells (g) in the extreme margin and the diffuse nature of the chlorenchyma, × 250; C, outline of lateral part of blade without midrib (m) and with tapering margin, × 160; D, anatomical detail of chlorenchyma, vascular bundles, adaxial ribs and sclerenchyma strands (s), × 250. E–H, abaxial epidermal structure as seen in surface view: E, macrohairs with single modified basal cell, microhairs and nodular silica bodies, × 250; F, interference contrast of macrohairs and silica bodies, × 250; G, lateral part of leaf blade with glandular marginal cells with persistent nuclei, × 250; H, sessile linear gland in leaf margin, × 250. A, B, G, *Ellis 5416*; C, F, *Ellis 2452*; D, H, *Ellis 5773*; E, *Ellis 5417*.

These same specimens were also examined by Davidse for a revision of the genus (Davidse 1988).

Central segments of leaf blades were removed and immediately fixed in FAA. Transverse sections and epidermal scrapes of these blade segments were prepared following the methods outlined in previous papers in this series (e.g. Ellis 1988).

The standardized terminology of Ellis (1976, 1979) was used for the anatomical descriptions. The following abbreviations are used in the descriptions:

vb/s – vascular bundle/s
1'vb/s – first order vascular bundle/s
2'vb/s – second order vascular bundle/s
3'vb/s – third order vascular bundle/s
ibs – inner bundle sheath; mestome sheath
obs – outer bundle sheath; parenchyma sheath

Specimens examined

Prionanthium dentatum

CAPE.—3119 (Calvinia): 15–16 km SE of Nieuwoudtville on Oorlogskloof road to Clanwilliam (–AC), *Ellis 2452* (16.10.1975), *5416, 5417* (20.9.1987), *5773* (11.10.1988).

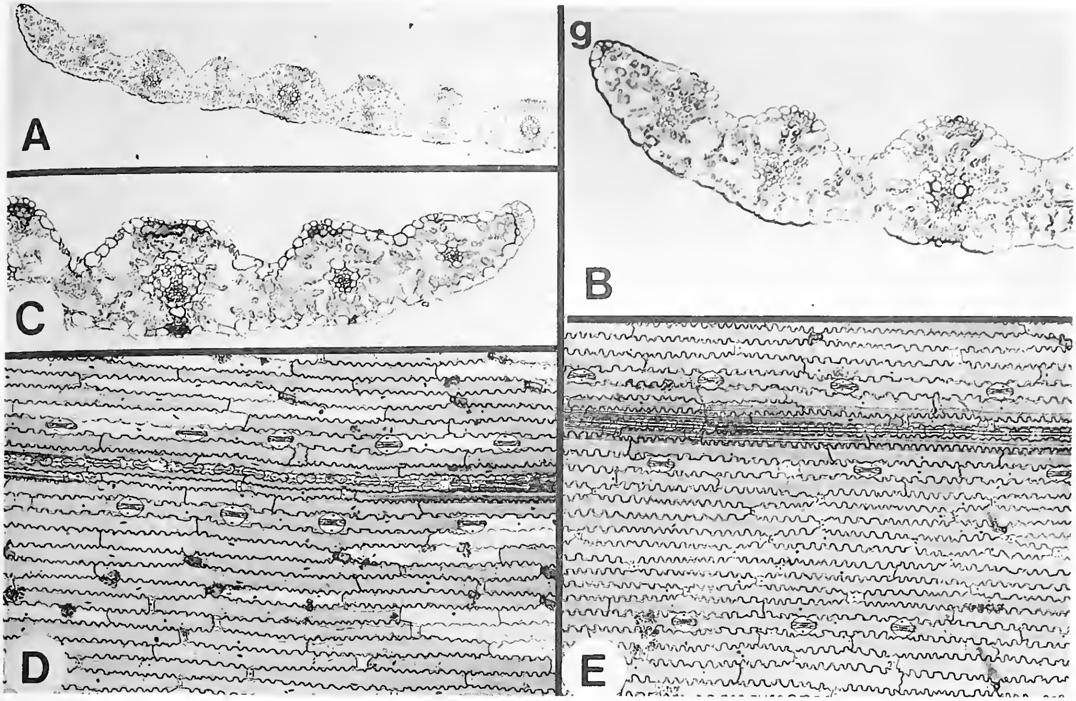

FIGURE 2.—Leaf anatomy of *Prionanthium ecklonii, Davidse 34018.* A–C, leaf in transection: A, outline with undifferentiated midrib and adaxial ribs, × 100; B, detail of gently tapering left hand margin with few glandular cells in extreme margin (g), × 250; C, detail of other margin, also with slightly enlarged epidermal cells constituting a sessile gland, × 250. E–F, abaxial epidermal surface anatomy: E, detail of sinuous intercostal long cells, dome-shaped subsidiary cells, microhairs and silica bodies, × 250; F, long cell, stomata, silica body and microhair structure, × 250.

Prionanthium ecklonii

CAPE.—3218 (Clanwilliam): 45 km N of Citrusdal (–BD), *Davidse 34018, Ellis 5784.*

Prionanthium pholiuroides

CAPE.—3318 (Cape Town): Darling Dist., 3 km E of Mamre Road, Rondevlei Farm (–BC), *Ellis 5433, 5434, 5435.* 3420 (Bredasdorp): 6 km N of Struisbaai (–CA), *Davidse 34053.*

LEAF ANATOMY OF THE GENUS *PRIONANTHIUM*

Leaf blade in transverse section

Outline: open, expanded, flat in *P. dentatum* and *P. ecklonii* (Figures 1A, C; 2A) but slightly inrolled to infolded in *P. pholiuroides* (Figure 3A, C, G). *Ribs and furrows*: medium to deep, open to narrow and cleft-like furrows present between all vbs. Similar rounded adaxial ribs associated with all vbs (Figures 1A–D; 2A–C; 3A–D, G). No abaxial ribs or furrows but slight undulations may be associated with the vbs (Figure 2A). *Median vascular bundle*: not structurally distinct from lateral 1'vbs. *Vascular bundle arrangement*: tends to vary across the lamina width with more 3'vbs between successive 1'vbs in the region of the median bundle than laterally; 3 (*P. ecklonii*) or 2 (*P. dentatum* and *P. pholiuroides*) 3'vbs between consecutive 1'vbs in region of median bundle but only 1 laterally in all species; 3 (*P. pholiuroides*), 5 (*P. ecklonii* and *P. dentatum*) and rarely 7 (*P. dentatum*) 1'vbs in leaf section. No 2'vbs. All vbs located in centre of blade. *Vascular bundle description*: 3'vbs elliptical with xylem and phloem distinguishable. 1'vbs round to elliptical in shape, phloem adjoins the ibs, metaxylem vessels very narrow with diameters much less than those of the obs cells (Figures 1B, D; 2B, C; 3B, D) with thin walls. *Vascular bundle sheaths*: double; round to slightly elliptical; obs often incomplete, particularly abaxially (Figure 3B, D, G); no extensions; obs cells inflated, rounded, the cells smaller than the chlorenchyma cells; walls thin; without chloroplasts or with few, small chloroplasts; ibs entire around all bundles; of small lignified cells with inner tangential and radial walls thickened. *Sclerenchyma*: adaxial sclerenchyma in the form of strands, either minute (Figure 2B, C), small (Figure 1B, D; 3B, D) or conspicuous (Figure 3G) in the Struisbaai population of *P. pholiuroides*; abaxial strands smaller and often not developed in association with the 3'vbs (Figure 3B, D, G). Fibres not lignified. Minute cap in margin but margin distinctly tapering in *P. dentatum* and *P. ecklonii* but not *P. pholiuroides*. No sclerenchyma present between bundles. *Chlorenchyma*: irregular, with no pattern in the cell arrangement; cells of different size and shape with conspicuous intercellular air spaces; occupy the entire area between the adaxial and abaxial epidermides, even the space above and below the vbs (Figures 1B, D; 2B, C; 3B, D, G); no arm cells or fusoids. *Colourless cells*: absent. *Adaxial epidermal cells*: small to medium-sized bulliform groups at bases of furrows in *P. dentatum* and *P. ecklonii* (Figures 1B, D; 2B, C), occupy less than ¼ leaf thickness, may be completely absent as in *P. pholiuroides* (Figure 3B, G); cuticle thin; epidermal appendages absent; no papillae although epidermal cells

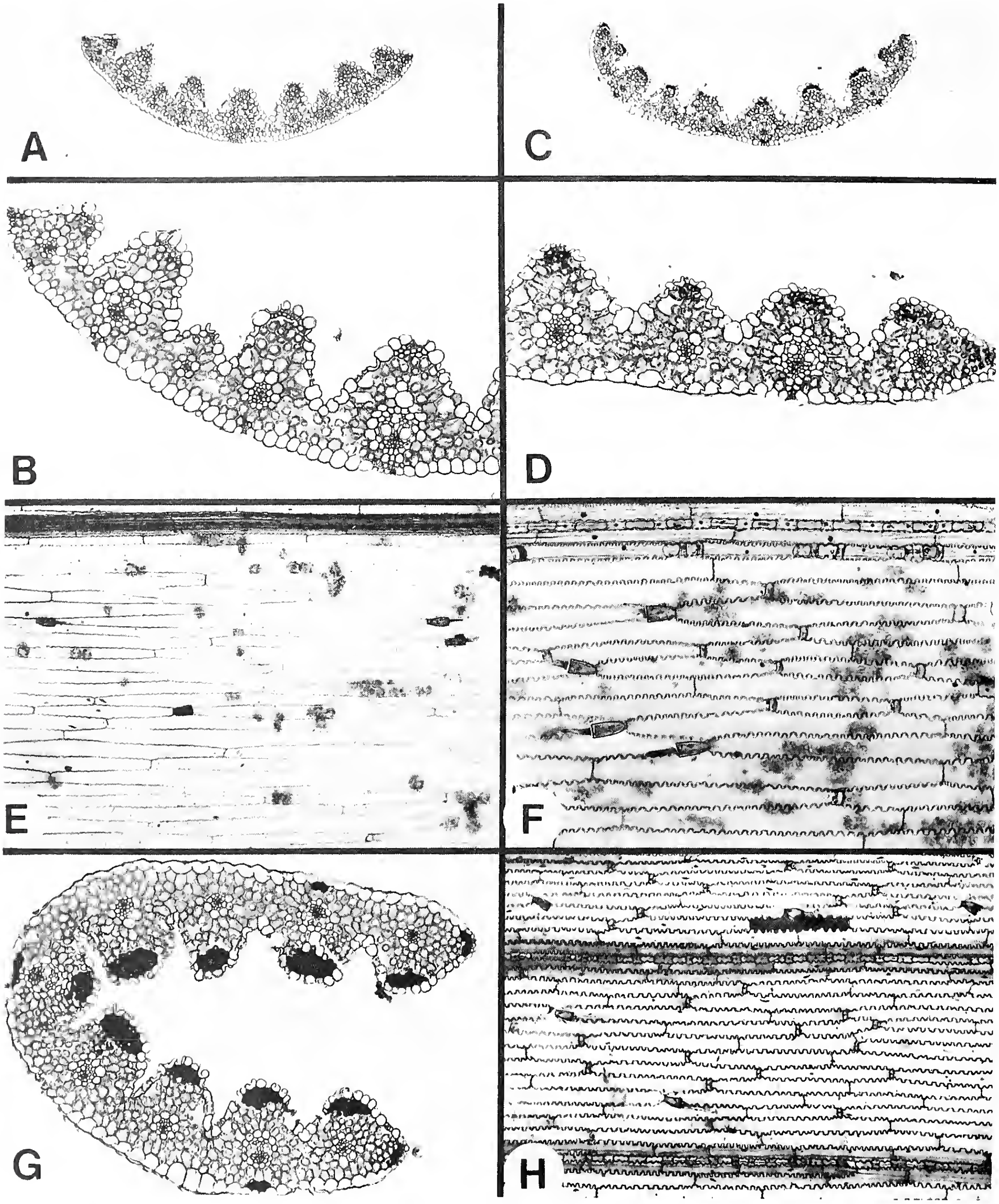

FIGURE 3.—Leaf anatomy of *Prionanthium pholiuroides*. A–F, specimens from the Mamre Road population. A–D, leaf blade transections: A, leaf outline showing vascular bundle arrangement and median vascular bundle not structurally differentiated from first order bundles, × 100; B, detail of leaf margin with no sessile linear gland cells, × 250; C, blade outline without midrib, × 100; D, detail of leaf margin with adaxial ribs and furrows, sclerenchyma strands, vascular bundles and chlorenchyma — note the absence of a narrow pointed margin with sessile glandular cells, × 250. E–F, abaxial epidermal preparations: E, intercostal long cells with thin, slightly sinuous walls, microhair basal cells and absence of stomata, × 250; F, long cells with sinuous walls, microhairs, stomatal absence and nodular silica bodies, × 400. G–H, examples of specimens from the Struisbaai population: G, leaf outline illustrating infolded nature of blade and well developed adaxial sclerenchyma strands, × 250; H, abaxial epidermis with sinuous long cell walls, microhairs, no stomata and variable, nodular silica bodies, × 250. A, B, E, *Ellis 5435*; C,F, *Ellis 5433*; D, *Ellis 5434*; G, H, *Davidse 34053*.

tend to be inflated. *Abaxial epidermal cells*: bulliform cells absent; similar in size to adaxial epidermal cells but all cells of uniform size; cuticle thin; no epidermal appendages present. Slightly enlarged sessile glandular cells present in the extreme margin in *P. dentatum* and *P. ecklonii* but absent in *P. pholiuroides* (Figures 1B; 2C); probably constitute part of marginal linear glands which appear to vary from 3–7 cells wide and are located on a distinctly narrow and projecting margin. These structures are also visible in surface view (Figure 1G, H) where the persistent nuclei are clearly visible.

Abaxial epidermis in surface view

Intercostal long cells: elongate, rectangular (Figures 1F, H; 2D, E; 3H) to fusiform (Figures 1E, G; 3E, F); walls virtually straight to moderately or deeply sinuous (Figure 4A, C, E); end walls vertical; walls unthickened to slightly thickened. Cell shape and size consistent across intercostal zones; long cells adjoin one another or separated by short cells; no bulliform cells. *Stomata*: usually absent in *P. pholiuroides* (Figure 3E, F, H) but present in *P. dentatum* and *P. ecklonii* (Figures 1E–H; 2D, E); low dome-shaped to dome-shaped subsidiary cells; 1–3 rows of stomata per intercostal zone; 1 elongate, rectangular interstomatal cell separates individual stomata in a file. *Intercostal short cells*: presence variable, either absent or irregularly present; when present usually paired; square to tall and narrow in shape. *Papillae* absent. *Prickles*: absent. *Microhairs*: present on all specimens; bicellular, but variable with basal cell either shorter than distal cell (Figures 3F; 4B, D) or the two cells equal in length (Figure 4F); hairs longer than stomatal length; distal cell deciduous and thin-walled. *Macrohairs*: usually absent but always present in *P. dentatum* (Figure 1E–H); rarely present in *P. pholiuroides*; unicellular, soft hairs with single inflated, hemispherical cell associated with the superficial base. *Silica bodies*: angular, irregular dumbbell-shaped to nodular; horizontally elongated; exclusively costal in very narrow (1–3 files) costal zones; separated by costal short cells.

DISCUSSION AND CONCLUSIONS

Differences between the species of Prionanthium

The three species of *Prionanthium* can readily be distinguished from one another on anatomical criteria as summarized in Table 1. *P. dentatum* is unique in the genus in possessing macrohairs but it otherwise resembles *P. ecklonii* very closely in leaf anatomy: both species have similar outlines, ribs and furrows, abaxial stomata and microhairs. They also share the very unusual marginal, sessile glands which are currently only known in four or five species of *Pentaschistis*. In addition to the macrohairs, *P. dentatum* and *P. ecklonii* also differ slightly in the arrangement of the vascular bundles and in the extent of the development of the sclerenchyma strands. *P. dentatum* and *P. ecklonii*, therefore, appear to be more closely related to each other than either is to *P. pholiuroides*. This agrees with the morphological evidence, particularly that of the glume glands where *P. dentatum* and *P. ecklonii* share similar stalked multicellular glands, whereas in *P. pholiuroides* the glands are sessile (Davidse 1988).

P. pholiuroides is distinct in the genus on the basis of a number of features: the leaf outline is inrolled to infolded; the adaxial furrows are narrow and cleft-like; there are fewer large vascular bundles in the leaf transection which is, consequently, narrower; the outer bundle sheath is often not entire but interrupted abaxially; the sclerenchyma strands may be conspicuous; the margin is not tapering and lacks the linear glands and abaxial stomata are absent or very rare. *P. pholiuroides* can, therefore, be readily separated from both *P. dentatum* and *P. ecklonii* on leaf anatomy and this study fully supports the recognition of these three species in the genus.

The results presented here must be interpreted with caution as only single populations of both *P. dentatum* and *P. ecklonii* were examined in this study due to the rarity of all the species. In the case of *P. dentatum* the same population was sampled on three different occasions — in the spring of 1975, 1987 and 1988. All these specimens are virtually identical in leaf anatomy and very little variation was exhibited. However, two populations of *P. pholiuroides* were included in the study and they exhibit obvious anatomical variation as illustrated in Figure 3. The Mamre population has more open leaves with smaller adaxial sclerenchyma strands than the Struisbaai population. Although these differences are visually rather striking, they do not represent significant differences, and characters such as vascular bundle number and arrangement, the cleft-like furrows and the absence of abaxial stomata remain consistent. It is of relevance to note that the Struisbaai population also differed cytologically from the Mamre population in the occurrence of a small B chromosome and this population was also the most variable in spikelet morphology (Davidse 1988). Nevertheless, it appears likely that most of the anatomical features separating the species will hold even when more material becomes available.

TABLE 1.—Anatomical differences between the three species of *Prionanthium*

	P. dentatum	*P. ecklonii*	*P. pholiuroides*
Outline	open, expanded	open, expanded	inrolled
Adaxial furrows	shallow, open, wide	shallow, open, wide	deep, narrow, cleft-like
No. 1'vbs in section	5 or 7	5	3
No. 3'vbs between 1'vbs	2	3	2 or 1
Outer bundle sheath	entire	entire	absent opposite phloem
Adaxial strands	small	minute	small or conspicuous
Bulliform cells	medium	small	small or absent
Margin in transverse section	projecting, narrow	tapering	abruptly pointed
Marginal glands	present	present	absent
Abaxial stomata	present	present	absent
Macrohairs	present	absent	absent

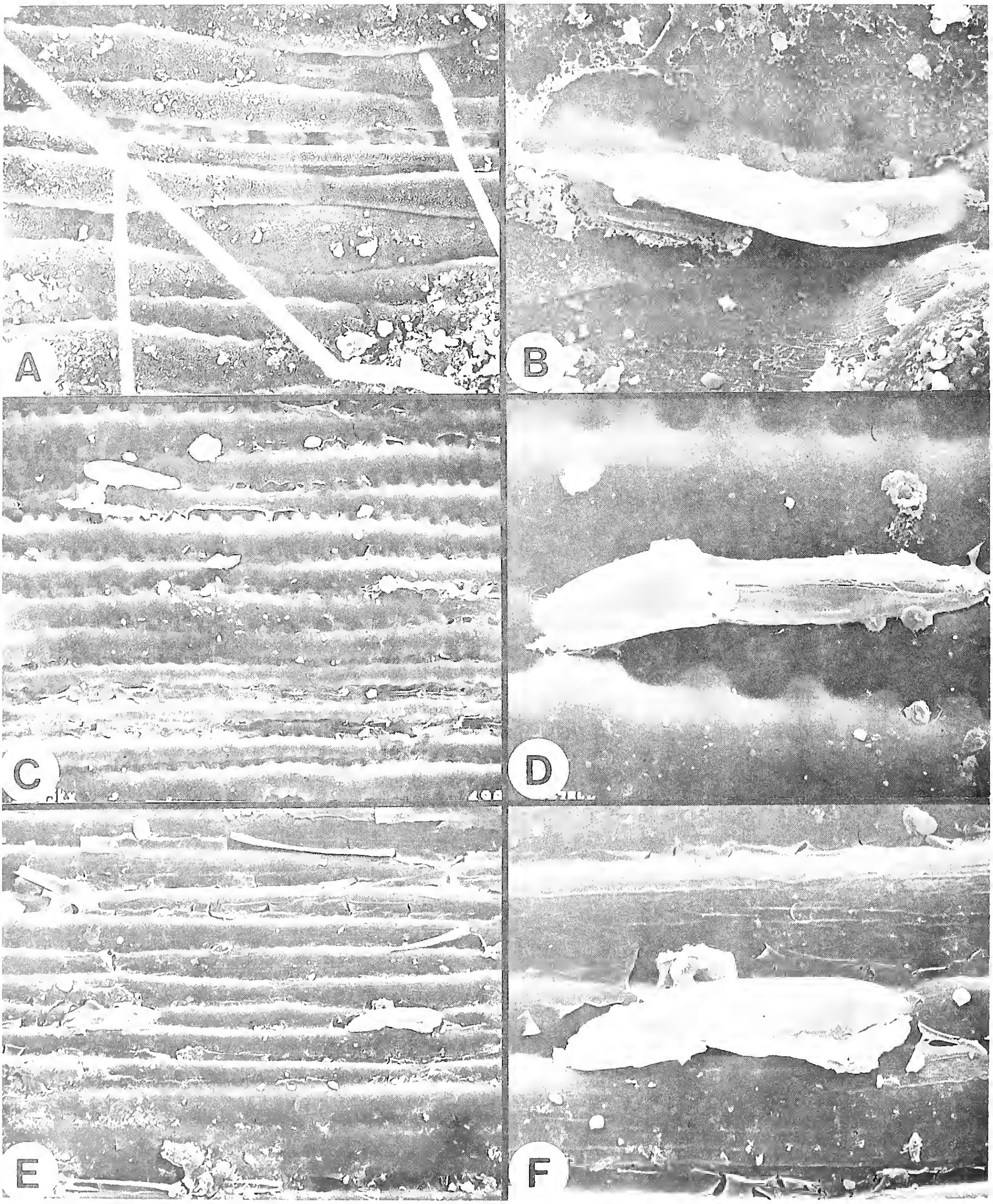

FIGURE 4.—SEM micrographs of the abaxial epidermis of different species of *Prionanthium*. A–B, *P. dentatum, Ellis 5416*: A, general epidermal features with macrohairs, stomata and inflated, slightly sinuous long cells, × 204; B, bicellular microhair with tapering distal cell, ×790. C–D, *P. ecklonii, Davidse 34018*: C, thickened, very sinuous long cells, stomata present (but not illustrated), × 210; D, bicellular microhair with distal cell longer than basal cell, × 810. E–F, *P. pholiuroides, Ellis 5433*: E, long cells slightly inflated and walls not undulating, stomata and macrohairs absent, × 210; F, microhair with basal cell longer than distal cell, × 780.

Subfamilial and tribal classification

Numerous characters of the leaf anatomy support the classification of *Prionanthium* in the Arundinoideae, confirming the reports of previous workers (Hansen & Potztal 1954; De Wet 1956; Renvoize 1986; Watson *et al.* 1986). The anatomy is C_3 with diffuse mesophyll, a double bundle sheath and without colourless cells accompanying the bulliform cells. This structure eliminates the possibility of panicoid or chloridoid relationships and the absence of fusoid and arm cells rules out a bambusoid alliance. The presence of microhairs, dome-shaped stomata and dumbbell to nodular silica bodies are all characters which are unequivocally

arundinoid and exclude pooid affinities. The anatomical evidence is, therefore, in full agreement with all other indications (Davidse 1988) and *Prionanthium* appears best placed in the Arundineae of the Arundinoideae.

Within the Arundineae the generic relationships of *Prionanthium* are subject to differing interpretations. Clayton & Renvoize (1986) are of the opinion that *Prionanthium*, and in particular *P. dentatum*, suggests a relationship with *Tribolium* and the other primitive arundinoid genera. Leaf anatomical characters can be used to substantiate such a relationship, particularly as all the primitive South African arundinoid taxa display similar mesophyll characteristics—which will here be termed the orthophyllous or mesic anatomical type. This differs significantly from the sclerophyllous type found in genera such as *Merxmuellera* and *Pentameris*. These two basic arundinoid anatomical types are discussed in Ellis (1988a) and *Prionanthium* shares many anatomical similarities with primitive genera such as *Tribolium* and *Urochlaena* (Ellis 1988a). However, other arundinoid genera not included in the heterogeneous group of primitive genera (Clayton & Renvoize 1986) also have this orthophyllous type of anatomy. *Chaetobromus* (Ellis 1988b), *Schismus, Karroochloa* and some species of *Pentaschistis* are examples and, therefore, the possession of the mesic type of arundinoid anatomy does not necessarily appear to indicate affinity.

Davidse (1988) proposes a distant relationship between *Prionanthium* and *Pentaschistis* based on several shared spikelet characters, the most important being the occurrence of well differentiated multicellular glands on the glumes of all three species of *Prionanthium* and on the glumes, pedicels and leaves of several species of *Pentaschistis* (Linder *et al.* in prep.). Although stalked multicellular glands do not occur on the leaves of *Prionanthium*, the presence of sessile, linear glands serves to strengthen the argument of affinities between these two genera.

The leaf glands do not appear to represent equivalent structures to the sessile glands of the glumes of *P. pholiuroides* which appear to be similar to the multicellular glands but lack the stalks. The sessile glands on the leaves are linear structures with the glandular tissue not aggregated into raised, cylindrical cones as is the case with the glume glands. *Prionanthium* is, therefore, unique in the possession of two gland types. In *Pentaschistis* both these gland types occur (Linder *et al.* in prep.) but not on the same plants or species and are characteristic of two different species groups. On the basis of this character alone *Prionanthium*, therefore, appears to be intermediate between the *Pentaschistis* species groups represented by *P. triseta* and *P. thunbergii* (Kunth) Stapf. Affinities with *Pentaschistis* are supported by the anatomical evidence, but a critical revision of *Pentaschistis* is needed before the phylogenetic links of *Prionanthium* become more lucid.

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Observations on plant usage in Xhosa and Zulu medicine

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Keywords: ethnobotany, pharmacognosy, practitioners, medicine, Xhosa, Zulu

ABSTRACT

The holistic concept of Xhosa and Zulu traditional medicine and some differences from Western orthodox practice are briefly outlined. The transmission of herbal knowledge within various social groups is outlined. The background, training and some procedures followed by five of the informants are discussed. Plant characteristics that may be seen, felt, smelled or tasted are considered as possible determinants of usage. The form of plant parts accounts for some usage in the more magically orientated medicines whereas colour, texture or the production of froth may signal the presence of medicinally active components such as tannin, mucilage and saponin. The role of plants producing a milky latex is discussed. Vesicant or irritant properties are utilized in septic or inflammatory conditions. Aromatic plants are used for respiratory or digestive disorders and pungent-smelling plants are used in the treatment of catarrh and some stress-related disorders. Bitter or sour-tasting plants may be used as an aid to digestion or serve a deterrent function. Parallel usage of some related plants in African and European herbal practice indicates that appropriate usage may be widely determined by easily discerned plant characteristics. Two herbal medicinal recipes recorded by the author and a list of medicinal plants collected in Transkei are presented.

UITTREKSEL

Die holistiese konsep in die tradisionele geneeskunde van die Xhosa en die Zoeloe, en enkele verskille van ortodokse Westerse gebruike word in hooftrekke beskryf. Die oorlewering van kennis omtrent kruie in verskillende sosiale groepe en die opleiding, agtergrond en prosedures wat gevolg is deur vyf van die verskeie beoefenaars met wie die onderhoude gevoer is, word bespreek. Plantkenmerke wat gesien, gevoel, geruik of geproe kan word, word beskou as moontlik bepalend vir gebruik. Die vorm van plantdele gee aanleiding tot hulle gebruik in die meer magies georiënteerde geneesmiddels, terwyl kleur, tekstuur, of die vorming van skuim 'n aanduiding kan gee van die aanwesigheid van medisinaal aktiewe komponente soos tannien, plantslym en saponien. Die rol van plante met melksap word bespreek. Blaartrekkende of irriterende eienskappe word aangewend in gevalle van septiese toestande en ontsteking. Aromatiese plante word gebruik vir respiratoriese of spysverteringongesteldhede en plante met 'n skerp, prikkelende geur word gebruik vir die behandeling van katar en sommige spanningstoestande. Plante met 'n bitter of suur smaak kan as hulpmiddel by spysvertering of as afskrikmiddel dien. Parallelle gebruik van sekere verwante plante in kruiegeneeskunde in Afrika en Europa dui aan dat gepaste gebruik algemeen bepaal word deur maklik onderskeibare kenmerke. 'n Lys van plante wat in Transkei versamel is, is opgestel en twee kruiegeneeskundige resepte wat deur die outeur opgeteken is, word gegee.

CONTENTS

INTRODUCTION

This study is an attempt to answer the question 'How do people know which plants to use?' in traditional Xhosa and Zulu medicine. Both the transmission of herbal knowledge and the apparent role of easily discernible plant characteristics as determinants of usage are considered. Botanical fieldwork, focussed mainly on the establishment of a herbarium at the University of Transkei, presented the author with an opportunity to collect and observe many of the plants known to be used in traditional medicine. Plant species listed in this paper were collected or observed in the company of an informant and further usage was recorded from interviews. Informants from Transkei included villagers, herbalists, traditional healers and homeopath/herbalists. The author attended two meetings with a group of ten Xhosa traditional healers at St Elizabeth's hospital in Lusikisiki, Transkei, in 1986 and was also present at a meeting held in Umtata, attended by

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a very large group of healers from many parts of Transkei. They met to discuss the possibility of joining the SA Traditional Healers Council. One meeting with a group of ± 30 traditional Zulu healers was attended at Valley Trust in Natal in 1987. Communal cultivation of medicinal plants in short supply, potential problems in the use of toxic plants, possible means of co-operation with the relevant institutions and some plant usage were among the topics discussed at these meetings.

TRADITIONAL XHOSA, ZULU AND WESTERN ORTHODOX MEDICINE

A background to Xhosa and Zulu traditional medicine

The first written records of Xhosa and Zulu medicinal plant usage were published as early as 1885 (Smith 1895) and 1909 (Bryant 1966). Smith (1895:6) refers to the age-old oral transmission of herbal knowledge as the 'heritage of experience'. In order to understand something of this heritage a few points on the underlying concepts of disease and its treatment need to be made, as these differ from the modern Western orthodox approach to medicine. A holism, involving both the relationship between body and mind in the individual and the relationship between the individual and his social and physical environment, is to be found in traditional Xhosa and Zulu attitudes to health and disease. Bryant (1966:16) refers to the recuperative powers of the Zulu as being possibly attributable to: 'his possession of a mind working in more perfect harmony with the requirements of the body'. Ngubane (1977) distinguishes between diseases believed by the Zulu to be caused by natural, biological factors and those believed to be caused by environmental factors. Traditional belief in the presence of the ancestors, sorcery, evil spirits and mystical forces that produce pollution are presented by her as being part of the perceived social and physical environment. These are the means by which a sense of moral order and of community is fostered. Although the ancestors are believed to cause some disease themselves when offended by a failure to carry out proper rites, their function is primarily a protective one. Through the medium of dreams they call the diviners to their profession and, through them, reveal the cause and nature of an illness and also direct its cure. Bryant (1966), Ngubane (1977) and Broster (1982) all refer to the high moral standing of the diviners within their society. The sense of responsibility healers feel towards the community and the realisation of the potential effects of one person's illness on the community was demonstrated by one of the healers interviewed (Mr V.M.—see informant 3). He said that if any member of a patient's family became ill during treatment, that person was treated by him without further charge. He also paid the medical costs of any one of his patients he felt needed the help of a Western-trained doctor while undergoing treatment. Traditional healers referred, on more than one occasion, to their custom of taking patients to stay in their own homes while undergoing treatment.

Some differences between traditional Xhosa, Zulu and Western orthodox medicine

The differences in the understanding of the cause of disease may account for the following differences from Western medicinal practice in forms of administration in traditional Xhosa and Zulu practice: 1, the wider use of emetics and enemas; 2, the use of snuff in stress-related disorders; 3, the rubbing of powdered medicines into scarifications on the joints; 4, the use of charms.

Ngubane (1977) refers to the extensive use of emetics and enemas to cleanse the body from harmful substances. Snuff-taking would have the same effect of cleansing the nasal passages and one group of healers, who passed snuff around before a meeting, said they were taking it 'to clear their minds'.

The rubbing of powdered medicines into freshly cut scarifications on the joints is attributed by Ngubane (1977) to the vulnerability of these areas to evil elements. Powdered medicines are also used for the relief of pain or as anti-inflammants. One healer (Mr V.M.) used this form of treatment for an ailment he referred to as rheumatism. He said that this ailment was caused by evil spirits.

Charms are used to ward off evil and also to procure the goodwill or affection of others. In Xhosa and Zulu practise, plant material may be taken, inhaled, bathed with, sprinkled, worn or simply grown. The use of charms may appear magical in the sense of being founded on belief in the supernatural rather than on observed effects that can be scientifically accounted for, but their function is a psychological, reassuring one. The status of this sort of categorization is liable to change, being dependent on the state of knowledge at any particular time. For example, the widespread use of love-charm emetics and various fertility cures or medicines taken to procure a given gender in the baby certainly appears to be more magically than medicinally based. It is possible, however, that constituents such as steroidal saponins, which are known to be present in many of the plants used, do affect the sex hormones.

TRANSMISSION OF HERBAL KNOWLEDGE

1 *Categories of practitioners*

Transmission of herbal knowledge takes place within social groups. Most of the fieldwork for this study was undertaken in the rural areas of Transkei and the practitioners observed could be roughly categorized into the following groups, which are also applicable to Zulu culture:

1.1 *Villagers* gather the plants used for various common minor ailments and some charm remedies for themselves. These plants are called by locally known common names and are often recognized by their leaves and used before flowers or fruit are present. In one village visited a very young child was sent out to collect a well known purge. He returned very quickly with a freshly dug up *Ledebouria* sp. which he had identified correctly from the Xhosa name. Some common ailment remedies such as the influenza and cold cure *Artemisia afra* Jacq. ex Willd. (Hutchings & Johnson 1986—see also the Appendix) appear to be used in all parts of Transkei and also in Zululand. It is known by the same name, *umhlonyane*, in both Xhosa and Zulu. Within the village, more specialised knowledge is common to smaller groups, such as the grandmothers who, from information apparently passed on through the family, collect the necessary plants and

prepare and administer medicines for their grandchildren. These medicines include the purges deemed necessary for the cleansing of the newly-born or weaning child from impurities believed to be passed on by the mother. They are known as *isicakathi* and *iyeza-lamasi* in Xhosa. Small boys know the plant charms which may be placed in the mouth or hair against the wrath of a teacher or father. Older men often know which plants to use to cure or prevent disease in stock animals.

1.2 *Herbalists* gather and sell or prescribe herbal medicines and may be either men or women. As herbalists's children frequently gather herbs with or for their parents, they grow up well informed in local plant lore and often become herbalists or healers themselves. Some herbalists support themselves by their trade, dealing with healers or selling directly to the public, often from street stalls. Some practise the craft for the benefit of their family or neighbours and earn their living by other means.

1.3a *Diviners* (known as *amgqirha* in Xhosa and *izangoma* in Zulu), keep contact with the ancestors, divine the causes of misfortune and illness and may treat patients themselves. They may also refer patients to specialist traditional doctors. Diviners are usually, but not always, women. They invariably receive a strong vocational calling which they themselves refer to as a sickness, known in Xhosa as *ukuthwasa*. They receive their training from practising diviners but never from a member of their own family, although the calling frequently comes through the medium of a departed relative, often the diviner's grandmother, who was herself a diviner. The period of training of the ten diviners interviewed varied from eight months to five years.

1.3b *Traditional doctors* (known as *amaxwhele* in Xhosa and *izinyanga* in Zulu) sell and prescribe herbal remedies for various ailments but do not usually divine the causes of an illness. According to Ngubane (1977) an *inyanga* is a male practitioner and a man who wants to become an *inyanga* is normally apprenticed to a practising *inyanga* for a period of not less than a year and the skill may be passed on to one of his sons. The men who attended the meeting in Umtata introduced themselves in English, using the title 'doctor'. Most of the women present wore the traditional head gear of a diviner.

There is an overlap between traditional doctors and diviners—many of the practitioners at the Valley Trust meeting described themselves as being both an *inyanga* and a *sangoma* and those interviewed in Transkei belonged to associations of 'traditional healers' which issued certificates of membership in English. The term 'healer' is used in this paper for both traditional doctors and diviners unless a distinction is necessary. The locally formed associations of traditional healers follow their own strict codes of ethics.

Knowledge of plant usage is taught in the field by trainers. At the meetings held at St Elizabeth's Hospital and Valley Trust specific plants were called by their local names, and their usage was quite openly discussed. Some individual forms of treatment used by diviners are revealed to them by their ancestors through the medium of dreams. Although some of these forms were discussed openly, the author was also requested to discuss others privately.

Illnesses are treated with herbal remedies which may consist of only one part of a plant or a mixture of various parts of one or more plants. Medicinal plants may be used fresh or may be dried in the sun and then stored in glass containers or hung from the rafters of huts. Roots and bark may be ground after drying. Sometimes insects or parts of animals are used and patent medicines may also be used.

1.4 *Homeopath/herbalists* undergo various correspondence courses in both herbalism and homeopathy. They frequently come from families of herbalists or traditional healers. They do not consult the ancestors and are the only group who appear to make use of published information. They may use either herbal or homeopathic remedies and study subjects such as human anatomy as well as diagnostic techniques such as reflexology or iridology. In Transkei they are referred to as 'Ooquira', the same term that is used for conventionally Western-trained doctors. One Transkeian homeopath running a correspondence course from Butterworth claimed to have over 400 students.

2 *Informants—background and practise*

The five informatns described below were all interviewed on more than one occasion and provided much of the information on plant usage referred to in this paper. It is difficult to assess how representative this small group is of the ancient traditional practise. However, many of the plants they use and customs they referred to have been recorded in the early literature. The vocational calling of diviners through the medium of dreams is well established (Krige 1950; Broster 1982).

1, Mrs S.M., a 75 year-old retired teacher whose parents had both been *herbalists*. She had acquired an expertise from them which she practised for the benefit of her large extended family and neighbours. When asked how she knew that a plant she described had been used by the Bushmen, she said simply 'through the ancestors'. She was introduced to the author by her son, a colleague in the Botany Department at the University of Transkei. At the time of the interviews she had charge of six grandchildren in a remote rural village. She was interviewed at her home where she provided recipes for herbal medicine, including the recipe for swollen glands recorded in this paper (see Recipe 1). She also accompanied the author on a plant collecting expedition to Camana Forest near Cofimvaba.

2, Mr C.M., a middle-aged *traditional healer* and owner of herbalist shops in Lusikisiki and Flagstaff. The son of a herbalist, he had received a calling in a dream while working as a builder in Durban. He walked to Zululand and found his trainer waiting for him, although there had been no written or verbal communication. His training took five years, during which time he had no communication with his family. He then returned to his home in Lusikisiki, where he set up his business. He attended the first meeting at St Elizabeth's Hospital and was later interviewed in one of his shops. He had started his business by collecting all his own plants but he now purchases plants from other collectors. He cultivates some in pots, including *Aloe aristata* Haw., which he uses for a variety of illnesses. He trains his own assistants to dispense medicines. He said that many of the illnesses his patients suffered from were believed by them to be caused by *umfufunyane* (an evil spirit) and thus needed to be seen to be treated by stronger

spirits, which he claimed to keep in beaded calabashes. This appeared to be a psychological ploy for coping with hysterical complaints. He had a special interest in the treatment of venereal diseases and also claimed an expertise in the treatment of difficult and delayed confinements.

3, Mr V.M., a middle-aged *traditional healer* who had been practising for two years after a training of eight months. He gave up his job as a transport manager on a mine in order to become a healer. He was called in a dream, in which he saw the face of his trainer, a woman living in Ladysmith in the Orange Free State. He attended both meetings at St Elizabeth's Hospital and was also interviewed twice, once at his own home. He described how he had been trained to feel in his own body, by concentration, the symptoms experienced by his patient. His special interest was that of his trainer—what he termed 'mental' illnesses. He said that he received a lot of help and advice from his neighbour, a more experienced healer who also attended both meetings. He cultivated a few medicinal plants in his garden among which were two *Chenopodium* spp. and *Artemisia afra* Jacq. ex Willd. He collected others in the field and had to buy some such as *iqwili* (*Alepidia amatymbica* Eckl. & Zeyh.) because, he said, it grows only in the mountains, and *umavumbuka* (probably *Sarcophyte sanguinea* Sparrm.) because that, he said, could only be found in Port St Johns. *Umavumbuka* he used not only for diarrhoea but also because he found it an important plant for what he described as 'bringing out the illness in a patient' (see Appendix and Recipe 1). He indicated that many of his patients were suffering from diseases caused by sorcery or evil spirits because of a disturbed and changing life style and he felt that some of the children's ailments he saw were caused by lack of adequate parental care.

4, Mr A.B., a middle-aged labourer of mixed Black and White parentage was the only *healer* interviewed who had not been formally trained. He claimed to have been instructed by his grandmother in dreams as to which plants to use. He attended the first meeting at St Elizabeth's Hospital and was obviously well known by the group of healers present. He was interviewed the following day at the hospital. He brought the author a bottle of medicine, the recipe and the plant *Drimiopsis maculata* Lindl. (*Hutchings 2225* KEI) used for the infant disease known as *ipleyiti*, discussed later in this paper.

5, Mr F.N. a 40 year-old *homeopath-herbalist* whose father had been a herbalist and taught him much traditional usage. He later studied herbalism and home-nursing by correspondence. He then completed a four year course in homeopathy with a correspondence college in England. The author met him in the University of Transkei herbarium where he came with a query about *Hypoxis* spp. He was subsequently interviewed at his surgery a number of times and accompanied the author on a brief collecting expedition in the vicinity of his surgery at Nqeleni in Transkei. He uses either herbal or homeopathic remedies but does not mix them. He employs iridology and reflexology in diagnosis. He has a trained hospital nurse working for him and he dispenses his own medicines. Many of the plants he uses grow in his garden. He sends his gardener out to collect others when needed and he buys some from herbal vendors. He has a special interest in cancer. He sometimes uses *Hypoxis* spp. corms to treat cancer and also, for uterine tumours, the young root of a *Phytolacca* sp. He attributed most of the illness he sees in babies and adults to malnutrition and also said that he frequently has patients suffering from hysteria caused by the belief that they have been bewitched. In the treatment of hysteria he often uses a tea made from *Viscum anceps* E. Mey. ex Sprague (see Appendix). He said an overdose could cause drowsiness, which passed in time, and he was careful to avoid using the plant when in fruit.

PLANT CHARACTERISTICS AS DETERMINANTS OF USAGE

Usage of related groups of plants for similar ailments is recorded in the literature and has been observed by the author. While transmitted knowledge obviously determines usage it seems that easily discernible plant characteristics were probably the original determinants. Some of these characteristics are outlined below with a few added examples from cultures other than Xhosa and Zulu.

1 *Characteristics that may be seen*

a. *Suggestive forms*

Some evidence of the role of suggestive forms in plant parts in Zulu folk medicine has been documented, mainly in connection with procreation-related conditions. A traditional healer's claim to be able to cure barrenness by the use of a corm resembling the female genitalia was recorded and published in 1927 (Bayer & Lebzelter). The same plant, *Gloriosa superba* L., has been recorded by Bryant (1966) and Gerstner (1939) as being given to parents wishing to have a baby of a particular gender and also as being used as an aphrodisiac, while Hulme (1954) records its use as a love charm emetic. The closely related *Sandersonia aurantiaca* Hook. and *Littonia modesta* Hook., with corms of a similar shape, are also recorded as aphrodisiacs (Gerstner 1939). *Crocosmia* and *Gladiolus* spp. are aptly described by Gerstner (1941: 375) as having a 'string of corms grown together' and recorded by him as being used to treat barren women. He compares the Zulu name of the medicine, *uNdwendweni* to *uDwendwe*—the wedding procession. He also records that various other Iridaceae species are carried during planting as charms to bring fertility to the crops. Hulme (1954: 10) records that a man, suspecting that his girl's love is waning, gives her an infusion of *Cyrtorchis arcuata* (Lindl.) Schltr. so that 'she will cling to him as the orchid clings to the tree'. The epiphytic orchids frequently sold in herbalists shops as love charm emetics or aphrodisiacs for men are likely also to be used on account of the form.

A parallel European example is that of the 'Mandrake' which was known as male or female according to the form of its roots. Desmond (1986) records that *Mandragora officinarum* L. (Solanaceae) was frequently illustrated in herbals, one of the earliest records known being in the Anglo Saxon Herbal (± 1 200). The roots of the plant were thought to resemble a human being and if pulled out were said to emit such a scream as to cause instant insanity or death in the collector. This could be avoided by ritual incantations or by having the roots pulled out by a dog, who would then go mad. The fearsome plant was highly valued as a powerful aphrodisiac. Early parallel usage of Orchidaceae is also known. Richter (1965) points out that

the origin of the name *orchis* is from the original Greek word for testicle. He claims that in medieval times, when the medical Doctrine of Signatures was adhered to, preparations from the tubers of certain orchids were regarded as sexual stimulants and also that a child of the required gender could be produced by using a tuber of the right age, the younger ones being thought to procure a male child.

b. *Colour*

While colour as a determinant has not been documented in the literature surveyed for this study, the author accompanied Mr F.N. in a search for the plant he knew as *umavumbuka* which differed from the author's description of *Sarcophyte sanguinea* Sparrm. He was looking specifically for a red material and eventually found, just below the surface of the ground, a very large reddish swelling on the root of an *Acacia karroo* Hayne tree that was neither of the two red parasites called 'Umavumbuka' by both the Zulu and Xhosa. These are *Sarcophyte sanguinea* Sparrm. and *Hydnora africana* Thunb. and both are used for diarrhoea and dysentery. The plant material was sent away for identification but no conclusion has yet been reached. *A. karroo* itself has a red root bark and inner bark and is used as an astringent medicine (Bryant 1966). It seems likely that the colour here does play a determinant role and possibly signals the presence of tannin, which is often present in the plants used for sore throats or diarrhoea and dysentery, and would be effective on account of its protein-precipitating, barrier-forming property. Bryant describes the inner bark of the 'uNgazi' tree as crimson and the roots of *Elephantorrhiza elephantina* (Burch.) Skeels = *E. burchellii* Benth. and an *Indigofera* sp. as red. All of these plants are used for diarrhoea and dysentery. Red streaking has been observed by the present author on Geraniaceae spp. used for the same purpose and was observed in the 17th century by Culpeper (1826) on 'Herb Robert' (=*Geranium robertianum* L.). This was used as an astringent 'to stay the blood'. It is also refered to by Flück (1976) as an anti-diarrhoeal and as used for inflammation of the mucosa of the mouth. Flück (1976) refers to the astringent properties and presence of tannin as well as to the red tinges frequently seen on the stem of *Polygonum hydropiper* L.

c. *Plants that froth in water*

Saponins are widely present in plants and may be detected by their property of frothing in water, a property which is made use of in the preparation of emetics. Mention has already been made of the large number of emetics used in traditional medicine and they are used for a wide range of conditions, including nausea, fever, snake-bite and coughs. They are also taken to induce the trances needed for divining, as love charms and as antidotes against bewitchment. Saponins have an irritant effect on the mucosa, which is why they make effective emetics. They are well known in the closely related Caryophyllaceae and Illecebraceae. *Silene* spp. and *Dianthus crenatus* Thunb. (both Caryophyllaceae) are used as Zulu emetics (Hulme 1954; *Gerstner 4666* PRE) while *Saponaria officinalis* L. (Caryophyllaceae), commonly known as 'soapwort' in English, is used as a mild laxative and expectorant in Europe (Flück 1976).

d. *Mucilage*

A mucilaginous exudate has been observed by the author in the bulbs of some Amaryllidaceae species used for wound healing and rashes and also in the purging medicine made from the bulbs of *Drimiopsis maculata* Lindl. This may be a guide to usage. Mucilage applied externally would promote healing by forming a barrier to further irritation. Taken internally, it has a laxative effect which is attributed by Flück (1976) to its property of swelling in water. The closely related Malvaceae and Tiliaceae families are known to be rich in mucilage (Trease & Evans 1983). This seems likely to be the constituent utilized in the *Hibiscus* and *Grewia* spp. used in the treatment of urinary disorders. Bryant (1966) records that the medicine is directly introduced through the urethral channels. *Grewia caffra* Meisn. and *Sida dregei* Burtt Davy are also recorded as being used in the treatment of sores and wounds (Gerstner 1938, 1939). Flück (1976) records the use of *Malva neglecta* Wallr. (Malvaceae) for abscesses and as a mild purgative in Europe.

e. *Milky latex*

The use of *Ficus sur* Forssk. (= *F. capensis* Thunb.) as a bovine galactalogue and *Sarcostemma viminale* (L.) R. Br. as a human and bovine galactalogue would appear to be on account of presence of the milky latex. The practice has been described as a matter of mimetic magic (Watt & Breyer-Brandwijk 1962). The milky latex found in many Euphorbiaceae, Apocynaceae and Asclepiadaceae may signal their toxicity and may have accounted for the wide African use of various species as arrow poisons or snake-bite cures. Gerstner (1939) records the use of *Euphorbia ingens* E. Mey. ex Boiss. as a purgative given in very small amounts. The latex is known to be highly irritant. Watt & Breyer-Brandwijk (1962) refer to African emetic and purgative use of *Euphorbia pugniformis* Boiss., which may have accounted for a reported death following medicinal administration. Culpeper (1826: 168) writes of 'petty spurge' (also Euphorbiaceae) as: 'The whole plant is full of a caustic milk, burning and inflaming the mouth ... a strong cathartic ... by reason of its sharp corrosive quality and therefore ought to be used with caution'.

2 *Characteristics that may be felt*

Bryant (1966: 57–59) refers to the use of various caustic plants including *Ranunculus multifidus* Forssk. (=*R. pinnatus* Poir.), *Mikania capensis* DC. and *Cardiospermum halicacabum* L. as poultices in the treatment of venereal sores, stating that they are 'said to burn away all the foulness of the ulcerated parts, leaving them clean, and stimulating them to rapid healing'. He suggests that the same principle is employed when *Croton* spp. are inserted into the womb in cases of uterine inflammation. Vesicant or caustic properties are known to be present in many species of Thymelaeaceae, Euphorbiaceae and Ranunculaceae. These properties are likely to account for the usage of many species from these families for skin complaints, wounds and sores and for their occasional use as cancer cures. Counterirritants recorded by Bryant (1966) include *Diospyros villosa* (L.) De Winter (= *Royena villosa* L.) and *Croton* spp. The stinging properties of various Urticaceae spp. would explain their use as sexual irritants for cattle or men, recorded by both Gerstner (1938) and

Bryant (1966). In Europe *Ranunculus* spp. are referred to as being rubbed into the skin for rheumatism by Flück (1976). Flück (1976) and Culpeper (1826) refer to the use of *Urtica* spp. for rheumatism.

Plants that have been recorded as irritant to the eyes, nose or mouth and are used for headaches or catarrh include *Andrachne ovalis* (Sond.) Muell. Arg. (Gerstner 1941) and *Synadenium cupulare* (Boiss.) L.C. Wheeler (Watt & Breyer-Brandwijk 1962).

3. *Characteristics that may be smelled*

Scented flowers do not appear to play a role in Zulu or Xhosa medicine, but sweetly scented or aromatic leaves or roots are sometimes used as cosmetic or purification washes. *Cymbopogon marginatus* (Steud.) Stapf ex Burtt Davy has an aromatic rootstock and, according to the Valley Trust group of healers, is used by the sangoma as a purification wash after funerals and by all women as a purification wash after menstruation. Hulme (1954) redords that the lemon-scented *Heteropyxis natalensis* Harv. is used as a perfume. The aromatic *Achyrocline stenoptera* (DC.) Hilliard & Burtt (= *Helichrysum stenopterum* DC.), is used by women to wash away body odours while *Helichrysum cooperi* Harv. is used as a wash by young men wishing to attract women (Watt & Breyer-Brandwijk 1962). *Helichrysum odoratissimum* (L.) Sweet is used by the Sotho to fumigate huts and to make a pleasantly perfumed ointment (Watt & Breyer-Brandwijk 1962). This plant is burnt by the Xhosa as an incense to invoke the ancestors and as a purification and protective charm (Hutchings & Johnson 1986).

The principal causes of aromatic odour in plants are volatile oils (Flück 1976), a number of which are known to have therapeutic or antispasmodic activity (Trease & Evans 1983). Species from the notably aromatic families, Rutaceae, Apiaceae, Lamiaceae and Verbenaceae, and various aromatic Asteraceae spp. are used by the Xhosa and Zulu for coughs, colds and influenza (see *Artemisia afra* Jacq. ex Willd. in Appendix) as well as carminative purposes. Back (1987) records that the strongly scented *Achillea millefolium* L. is used in England for feverish colds and indigestion or flatulence.

Aromatic or pungent-smelling plants used in stress-related disorders include *Clausena anisata* (Willd.) Hook. f. ex Benth., the pounded roots of which are used in an emetic for people made ill by evil spirits or the ancestors (pers. comm.). The peppermint-smelling roots of *Monanthotaxis caffra* (Sond.) Verdc. are smoked for hysteria (Gerstner 1939). The plant is also used as a charm against bad dreams (Watt & Breyer-Brandwijk 1962). *Ocotea bullata* (Burch.) Baill. and *Cardiospermum halicacabum* L. are among the strong-smelling plants used to relieve headaches and catarrh (Hulme 1954; Watt & Breyer-Brandwijk 1962). A *Kaempferia* sp. is referred to by Watt & Breyer-Brandwijk (1962) as good for catarrh, driving away snakes and warding off lightning. Taken in mealiemeal, it is supposed to keep away the effects of drought and heat and also to protect the inyanga from the dangerous effects of the plants collected. Garlic-smelling *Tulbaghia* spp. are grown by both the Xhosa and Zulu to keep snakes away from the homestead and smeared on the bodies of Xhosa diviners before dancing as a protective device (pers. comm.) Gerstner (1938) records that a number of strong-smelling Apiaceae and Lamiaceae are grown to keep away evil spirits.

Culpeper (1826: 59) writes of 'common feverfew' (*Chrysanthemum* sp.): 'Its unpleasant foetid smell bespeaks it useful in hysteric disorders'. The drug Valerian, often used in Europe as a carminative and antispasmodic in hysteria and nervous disorders comes from *Valeriana officinalis* L. (Trease & Evans 1983) and is commonly called by English botanists 'stinking *Valerian*' on account of the odour that develops when the root is dried.

Strong-smelling plants are also often used by the Xhosa and Zulu as anthelmintics e.g. *Clausena anisata* (Willd.) Hook. f. ex Benth. and *Clerodendrum glabrum* E. Mey., or as insect repellants e.g. *Cymbopogon marginatus* (Steud.) Stapf ex Burtt Davy (= *Andropogon marginatus* Steud.) and *Andrachne ovalis* (Sond.) Muell. Arg. (Watt & Breyer-Brandwijk 1962; Gerstner 1941). The strong-smelling *Chrysanthemum parthenium* (L.) Bernh. is an English insect repellant (Back 1987).

4 *Characteristics that may be tasted*

The sour-tasting leaves of *Embelia ruminata* (E. Mey. ex A. DC.) Mez and a *Pavetta* sp. are chewed as a tonic (Gerstner 1938). The roots of *Mondia whitei* (Hook. f.) Skeels, chewed for the relief of indigestion, taste first bitter and then sweet (Gerstner 1941). Bryant (1966) records that the very bitter *Vernonia adoensis* Sch. Bip. ex Walp. (=*V. woodi* O. Hoffm.) is said to be a useful stomachic. A number of *Aloe* spp. are recorded by Gerstner (1941) as being applied to the mother's breast at weaning. The known bitter taste of many species would surely account for their use in discouraging suckling. Any fieldworker who has collected Asclepiadaceae spp. would understand the use made of the bitter latex when applied to eggs to deter dogs from stealing them as recorded by Hulme (1954).

The bitter taste of aloes was recorded by Culpeper (1826). The purgative properties of *Aloe* spp. are noted in the *Oxford English Dictionary*, with English citations going back to the 14th century and etymological evidence going back to Latin and Greek. The use of the bitter *Artemisia absinthum* L. and *A. vulgaris* L. as digestion stimulants was recorded by Flück (1976).

5 *Conclusion*

Jensen & Nielsen (1984) point out that chemistry has always been used in the classification of plants, exemplifying chemical characters by the colour, taste and smell of various parts of the plant. It would seem from parallel usage of related plants in African and European herbal practice that appropriate usage may be widely determined by easily discerned plant characteristics.

PLANT USAGE IN TRANSKEI

Medicinal plants were collected and their usage recorded by the author in Transkei from 1983–1987 (see Appendix). The categories of informants interviewed include the following:

Villagers: (a) villagers encountered by chance on collecting trips; (b) some inhabitants of Ndunguniyeni Village in the Engcobo area of Transkei; (c) staff and students who either brought the author plants or were with the author when plants were collected. They recalled plant usage from their earlier experience in the rural areas.

Herbalists: (a) Mrs S.M. (informant 1 above); (b) a herbalist who visited the herbarium and discussed various medicinal plants on display; (c) street vendors from whom plants were bought by the author.

Healers: (a) Mr C.M. (see informant 2 above); (b) Mr V.M. (see informant 3 above); (c) healers attending the St Elizabeth's Hospital and Valley Trust meetings.

Homeopath/herbalist: Mr F.N. (see informant 5 above).

All the plants in the Appendix, with the exception of *Sarcophyte sanguinea* Sparrm. and the *Hypoxis* spp., were collected or observed by the author in the company of an informant. The anti-diarrhoeal use of *Sarcophyte sanguinea* was recorded from many informants and its Xhosa name was confirmed from a pickled herbarium specimen (*Johnson 222* KEI). This had originally been collected for the herbarium by a traditional healer from Kei Mouth. *Hypoxis* spp. were shown to Mr F.N. so that he could confirm his identification of the genus and were also discussed by their Zulu names at the Valley Trust meeting. The plants listed in the Appendix were selected on account of properties which appear to the author to indicate a possible appropriate usage.

RECIPES FOR HERBAL MEDICINES

Recipe 1: medicine for swollen glands

The following recipe for swollen glands was given to the author by Mrs S.M. (informant 1 above) in the presence of her son, who is a botanist. Mrs S.M. said that the medicine was also effective against cancerous growths. Unfortunately the four ingredients were recorded during a drought and not collected. It was possible to make hypothetical determinations from the Xhosa names and the plant descriptions. The recipe is included for its information on method. Although the plants used are different, the way in which the medicine is prepared and used is similiar to that described by Bryant (1966) for the treatment of tumours ascribed by him to scrofula.

Method: mash and boil the roots of *isinama* and *amaselwa* and the rootstock of *umavumbuka* to make one litre of pulp. Place the cooking pot while it is still hot on a folded shawl on the patient's head for neck glands, chest for armpit glands and stomach for groin glands. When cool enough use the mixture directly as a poultice on the affected glands. When further cooled, add two teaspoons of *imithombo* as a ferment and give the patient two spoonfuls as necessary.This medicine has a bad taste and may be diluted.

The four ingredients are interesting. *Isinama* was described as sticking to clothing and is likely to be the common weed *Achyranthes aspera* L. (Amaranthaceae), which is also called *isinama* by the Zulu. Watt & Breyer-Brandwijk (1962) record that the leaf and seed are applied in India to inflamed and enlarged glands. Oliver-Bever (1986), quoting Neogi *et al.* (1970), refers to the diuretic and slightly anti-pyretic properties of achyranthine, the betaine derived from the plant. She also tables the anti-leprosy action of the seeds produced by the oleanolic glycoside, referring to the work of Gopalachari & Dhar (1958) and Ojha *et al.* (1966).

Amaselwa was described as the calabash creeper and identified by the informant's son as being either *Lagenaria siceraria* (Molina) Standl. or *L. sphaerica* (Sond.) Naud. (Cucurbitaceae). A pounded root decoction of *L. sphaerica* has been recorded by Hulme (1954) as being used by the Zulu for treating a swollen body caused by some blood disorder. Watt & Breyer-Brandwijk (1962) refer to a small form of *L. siceraria* which is thought to contain amygdalin and so to be cyanogenetic. Another member of the family, *Momordica charantia* L. is referred to in the following extract (Sofowara 1982: 208): 'With alcoholic extracts of the stems, leaves and fruits Abbott *et al.* (1966) demonstrated remarkable anticancerous action on mice with transportable 180 tumours. Aqueous extracts of the roots also proved effective in reducing the tumour'.

Imithombi is a solidified fermented paste made from the fruit of a cultivated *Sorghum* sp. The stem pith has been recorded as being used by the Xhosa to treat tubercular swellings (Watt & Breyer-Brandwijk 1962). *Sorghum* is one of the genera cited as containing cyanogenic compounds and free HCN by Nartey (1981: 73). He writes: 'cyanogenic glycosides are reputed to possess some therapeutic properties against cancer. Their action against cancer cells produces large amounts of B-glucosidases, so that HCN produced by the enzymic cleavage of, for example amygdalin and prunasin, exerts its full inhibitory influence on the growth of neoplastic cancer cells'.

Umavumbuka, described by the informant as having a red rough-textured rootstock with red sap and small white flowers and growing on the roots of old trees, is likely to be the parasite *Sarcophyte sanguinea* Sparrm., referred to in the Appendix as a diarrhoea remedy. While no chemical research on this plant is known to the author, another parasite, *Hydnora johannis*, from the Sudan, has been found to have a high concentration of phenolic compounds in the roots, imparting an astringent quality which would account for its antidiarrhoeal use (Visser & Musselman 1986). *Hydnora africana* Thunb. is also known to the Zulu as *umavumbuka* and is similar in colour and habit to *S. sanguinea*, both being found on the roots of trees. A species from another parasitic genus, *Viscum* has been used in Africa for the removal of warts (Watt & Breyer-Brandwijk 1962) and it has been recorded that *V. album* L. may inhibit the growth of certain tumours if applied directly on or into the tumour (Flück 1976).

Recipe 2: medicine for ipleyiti

Ipleyiti is an alleged disease of newly born and very young infants described variously by several informants as 'producing an old look in the newly born', 'producing green veins stretching from the arms to the stomach', 'the result of a placenta formed like an enamel plate', 'producing much crying and green stools'. It is a condition frequently treated by traditional healers. It was ascribed by one healer, Mr V.M. to unsuitable behaviour on the part of the mother, such as going to too many drinking

APPENDIX.—Medicinal plant usage recorded in Transkei, 1983–1987

Plant; family; Xhosa name	Category of informant	Part used/preparation/application/ailment	Record/habitat/voucher (KEI)	Observed characteristic/ indicated constituent	Indicated activity
Alepidea amatymbica Eckl. & Zeyh.; Apiaceae; *iqwili*	Villager; herbalist; healer; homeopath	Root sucked for sore throat and for coughs and colds	Recorded and confirmed by informant from *Hutchings 2175*	Aromatic, resinous, tastes of turpentine	Antihypertensive*; antimicrobial*; diuretic*
Aloe striatula Haw.; Liliaceae; *ingcelwane*	Herbalist	Crushed root infusion administered orally or as an enema for constipation	Growing as kraal fence. *Hutchings 846*	Aloins and resins recorded in *A. ferox* Mill. (Watt *et al.* 1962)	Reputed purgative action in *A. ferox* Mill. (Watt *et al.* 1962)
Artemisia afra Jacq. ex Willd.; Asteraceae; *umhlonyane*	Herbalist; healer; homeopath; villager	Plant infusion drunk or inhaled or leaves inserted in nostrils for influenza/colds	Cultivated by healer. Collected in open grassland. *Hutchings 392*	Aromatic, bitter taste reported by an informant	Antihistamine*; narcotic*; analgesic*
Brunsvigia grandiflora Lindl.; Amaryllidaceae; *isichwe*	Villager	Outer bulb scale used as circumcision dressing —rapid healing reported	Open grassland collected and cultivated in author's garden	Mucilagenous drops on bulb scale	Protective anti-irritant coating from mucilage
Bowiea volubilis Harv. ex Hook.; Liliaceae; *umgagagana*	Herbalist	Bulb boiled, water changed many times then used as a purgative	Forest margin. *Hutchings 837*	Bulb irritant to touch. (Watt *et al.* 1962). Cardiac glycosides	Toxic, produces extreme gastric irritation. (Watt *et al.* 1962)
Carpobrotus edulis (L.) L. Bol.; Mesembryanthemaceae	Homeopath	Leaves chewed or sap extracted for sore throats. Sap used for allergies and diabetes	Observed cultivated in homeopath's garden	Succulent. Catechol tannins (Watt *et al.* 1962)	Antiseptic (Watt *et al.* 1962); astringent
Chenopodium spp.; Chenopodiaceae; *iyeza-lomkondo*	Healer	Ground leaves mixed in a medicine rubbed into cuts on painful joints caused by sorcery or evil spirits. Medicine also taken orally	Cultivated by healer. *Hutchings 2259, 2260*	Vitamin C; mucilage; iron; salts; (*C. bonus-henricus* L.) (Chiej 1984; Watt *et al.* 1962)	Antiscorbutic (*C. album* L.) (Watt *et al.* 1962); antispasmodic; anthelmintic; diaphoretic (*C. ambrosioides* L.)
Duchesnea indica (Andr.) Focke; Rosaceae; *igunube*	Herbalist	Crushed roots an ingredient in a decoction for diarrhoea known as *isisusenja*	Recorded from description—observed growing in disturbed areas	Tannins common in family	Related plants, e.g. *Alchemilla* spp. antidiarhoeal, anti-inflammatory (Flück 1976)
Hypoxis spp.; Hypoxidaceae; *inongwe* (Xhosa); *inkomfe* (Zulu)	Homeopath; healers	Rhizome extraction used for heart palpitations and cancer by homeopath and for hysteria and ulcers by Zulu healers	Recorded from local and botanical names and genus confirmed by homeopath from herbarium specimens	Yellow rhizome	Anti-tumour (Drewes *et al.* 1983)
Matricaria nigellifolia DC. var. *tenuior* DC.; Asteraceae; *umhlonyane*	Villager; herbalist	Leaf and stem infusion drunk for influenza	Stream banks on commonage. *Hutchings 377*	Aromatic. Volatile oils in related spp.	Carminative

* Personal communication from Noristan Laboratories.

APPENDIX.—Medicinal plant usage recorded in Transkei, 1983–1987 (continued)

Plant; family; Xhosa name	Category of informant	Part used/preparation/application/ ailment	Record/habitat/voucher (KEI)	Observed characteristic/ indicated constituent	Indicated activity
Pachycarpus concolor E. Mey.; Asclepiadaceae; *ishongwe*	Villager; herbalist; healers	Dried ground tuber used for stomach pains (a spoonful in cold water) also used as snuff for headaches and hysteria	Open grassland, information also recorded using Xhosa plant name. *Hutchings 347*	Bitter taste	Cardiotonics in family (Oliver-Bever 1986)
Pelargonium sidifolium (Thunb.) Knuth; Geraniaceae	Herbalist	Crushed roots an ingredient in a remedy for *intsila* stomach disease in small babies and also in a decoction for severe diarrhoea (*isisu esikhulu*)	Disturbed grassland commonage. *Hutchings 845*	Red root. Tannins in genus (Watt *et al.* 1962)	Astringent [*P. luridum* (Andr.) Sweet] (Watt *et al.* 1962)
Pentanisia prunelloides (Klotzsch ex Eckl. & Zeyh.) Walp.; Rubiaceae; *icikamlilo*	Homeopath	Dried powdered tubers used for diarrhoea and vomiting and in fever remedy	Observed in field next to surgery of homeopath		Anti-biotic*; family has many anti-pyretic properties (Oliver-Bever 1986)
Phytolacca octandra L.; Phytolaccaceae; *Iyeza lesilonda*	Villager	Leaves applied to septic wound caused rapid healing	Collected by ranger for author. *Hutchings 2299*	Saponoside (Oliver-Bever 1986)	Anti-inflammatory (Oliver-Bever 1986)
Plantago lanceolata L.; Plantaginaceae	Homeopath	Dried powdered leaves mixed with *L. major* L. in vaseline for sores	Cultivated in garden of informant	Mucilage and aucubin (Flück 1976)	Soothing (Flück 1976)
Plantago major L.; Plantaginaceae	Homeopath	Dried powdered mixed with *L. lanceolata* L. in vaseline for sores	Cultivated in garden of informant. *Hutchings 2291*	Mucilage and aucubin (Flück 1976)	Wound healing (Flück 1976)
Punica granatum L.; Punicaceae; pomegranite	Herbalist	Rind an ingredient in decoction drunk for diarrhoea (*isisu senja*)	Recorded from English name. Trees cultivated in area	Red rind. Tannin found in rind	Astringent
Rhus dentata Thunb.; Anacardiaceae; *ntlolokoshane*	Villager; homeopath	Fruit eaten to relieve thirst, leaves used in sore throat remedy	Observed and collected. *Hutchings 52*	Fruit sour, Tannins known in some spp. (Watt *et al.* 1962)	Anti-inflammatory* (*Rhus* sp.)
Rumex sp.; Polygonaceae	Homeopath	Leaf infusion drunk for indigestion	Growing in homeopath's garden. *Hutchings 2290*	Lemon-scented. Anthraquinones common in genus (Trease *et al.* 1983)	Purgative
Sarcophyte sanguinea Sparrm.; Balanophoraceae; *umavumbuka*	Herbalist; healer; homeopath	Crushed rootstock an ingredient in decoction drunk for diarrhoea (*isisu senja*)	Recorded from name and description, confirmed by *Johnson 222*	Red rootstock	?Astringent (*Hydnora* spp.) (Visser *et al.* 1986)
Schinus molle L.; Anacardiaceae; pepper tree	Herbalist	Leaf infusion inhaled or drunk for cold and influenza	Observed in garden	Aromatic, pungent-tasting. Resin, volatile oils*	Analgesic*; anti-inflammatory*; anti-hypertensive*; antidepressant*; anti-arrythmia*

* Personal communication from Noristan Laboratories.

APPENDIX.—Medicinal plant usage recorded in Transkei, 1983–1987 (continued)

Plant; family; Xhosa name	Category of informant	Part used/preparation/application/ailment	Record/habitat/voucher (KEI)	Observed characteristic/ indicated constituent	Indicated activity
Solanum supinum Dun.; Solanaceae; *umtumna*	Herbalist	Ground roots an ingredient in a decoction for severe diarrhoea (*isisu esikhulu*)	Disturbed grassland commonage. *Hutchings 847*	Solanine	Antibacterial *S. nigrum* L. (Oliver-Bever 1986)
Sutera aurantiaca (Burch.) Hiern; Scrophulariaceae; *phantsi-komthu*	Herbalist	Leaf infusion inhaled or drunk for cold and influenza. Leaves also inserted in nostril	Open grassland. *Hutchings 836*	Aromatic, therefore may contain volatile oils	Carminative
Sutera pauciflora (Benth.) Kuntze	Villager	Plant used as anthelmintic	Disturbed commonage. *Hutchings 1534*	Triterpenoid and steroidal saponins in family (Trease *et al.* 1983)	Toxic irritant
Viscum anceps E. Mey. ex Sprague; Viscaceae; *isiselde*	Homeopath	Plant sued to treat hysteria and skin complaints	Parasite on *Acacia* sp. *Hutchings 2262*	Sticky; choline; acetylcholine; inositol (*V. album* L.) (Chiej 1984)	Hypotensive; vasodilatory; anti-epileptic; diuretic (*V. album* L.) (Chiej 1984)
Xysmalobium undulatum (L.) Ait. f.; Asclepiadaceae; *ishongwe*	Villager; herbalist; healers; homeopath	Dried ground tuber used for stomach pain, as a purgative and as snuff for hysteria and headaches	Recorded from Xhosa name and collected in open grassland. *Hutchings 2294*	Bitter taste; acid saponin	Weak CNS depressant*; anti-depressant*; antiarrythmia*

* Personal communication from Noristan Laboratories.

parties before giving birth, or to sorcery. The homeopath/herbalist, Mr F.N. said that the cases he sees are either cases of colic or are babies born to mothers suffering from malnutrition. One informant from a village said that the disease had come from Zululand. This belief is also mentioned by Broster (1982), who confirms the high incidence, the deformed placenta and the attribution to sorcery. She states that a baby suffering from the disease is usually born prematurely and remains sickly. The disease is also known among the Zulu, and Ngubane (1977) suggests that the Zulu term *ipleti* is used in a manner that suggests deprivation and starvation.

The recipe for medicine for *ipleyiti* was provided by Mr A.B. The plant used is *Drimiopsis maculata* Lindl. and the author was able to see the medicine as well as to collect the plant (*Hutchings 2225* KEI). The medicine is known as *nstwilisa* or *nomatyuntyuma*.

Method: crush the bulbs and add cooled, boiled water (± 4 bulbs to 250–300 ml water, depending on size of bulbs). Add a pinch of salt to preserve the medicine, which will last for about ten days. The dose varies from one teaspoon to a tablespoon as required. For older children, a spoonful of Epsom salts may be added.

The medicine was very slimy, indicating the presence of mucilage. Mr V.M. confirmed that he used the same plant for treating *ipleyiti*. The bulbs of *Drimiopsis maculata* are recorded by Hulme (1954) as being used by the Zulu. They are steeped in water to make an enema for young children with stomach trouble.

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Invasive alien woody plants of Natal and the north-eastern Orange Free State

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Keywords: alien, coastal communities, forest, grassland, KwaZulu, Natal, Orange Free State, savanna, survey, invasive plants (woody)

ABSTRACT

The frequency and abundance of invasive alien woody plants were recorded along roadsides and at watercourse crossings in 87% (152/175) of the quarter degree squares in the study area. The survey yielded 130 species of which the most prominent species (in order of prominence) in roadside and veld habitats were: *Chromolaena odorata, Solanum mauritianum, Psidium guajava, Rubus* spp., *Acacia mearnsii* and *Lantana camara*. The most prominent species (in order of prominence) in streambank habitats were: *Acacia dealbata, A. mearnsii* and *Salix babylonica*.

The greatest intensity of invasion was recorded in the Natal midlands and in the coastal belt of southern Natal, including the metropolitan areas of Pietermaritzburg and Durban. There was relatively little invasion in the north-eastern lowlands of Natal but the potential for expansion is great. Little invasion was recorded in the north-eastern Orange Free State except along some watercourses.

UITTREKSEL

Die frekwensie en volopheid van uitheemse houtagtige indringerplante is langs paaie en by oorgange oor waterlope in 87% (152/175) van die kwartgradevierkante in die studiegebied aangeteken. Daar is 130 indringers aangetref waarvan die mees prominente (in volgorde van prominensie) *Chromolaena odorata, Solanum mauritianum, Psidium guajava, Rubus* spp., *Acacia mearnsii* en *Lantana camara* langs paaie en in veldhabitats was. Die mees prominente spesies (in volgorde van prominensie) langs stroomoewers was *Acacia dealbata, A. mearnsii* en *Salix babylonica*.

Die ergste indringing is in die Natal middelland en in die kusstreke van suid-Natal aangetref, met insluiting van die stedelike gebiede van Pietermaritzburg en Durban. Daar was betreklik min indringing in die noordoostelike laagland van Natal maar die potensiaal vir uitbreiding is groot. Behalwe langs waterstrome, is daar min indringing in die noordoostelike Oranje-Vrystaat aangeteken.

CONTENTS

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INTRODUCTION

Survey history and objectives

This study, which covers Natal and the adjacent north-eastern Orange Free State is the second of eight regional surveys which together are designed to reflect invasion by woody alien plants in the Republic of South Africa as a whole. The survey method was developed during a study of the south central region of the Transvaal (Wells *et al.* 1980) and then used in a survey of the rest of the Transvaal (Henderson & Musil 1984). This survey of Natal and the north-eastern Orange Free State was undertaken during the 1986/87 summer season.

The objectives of the survey are: to produce a checklist of the major invasive alien woody plants of streambank,

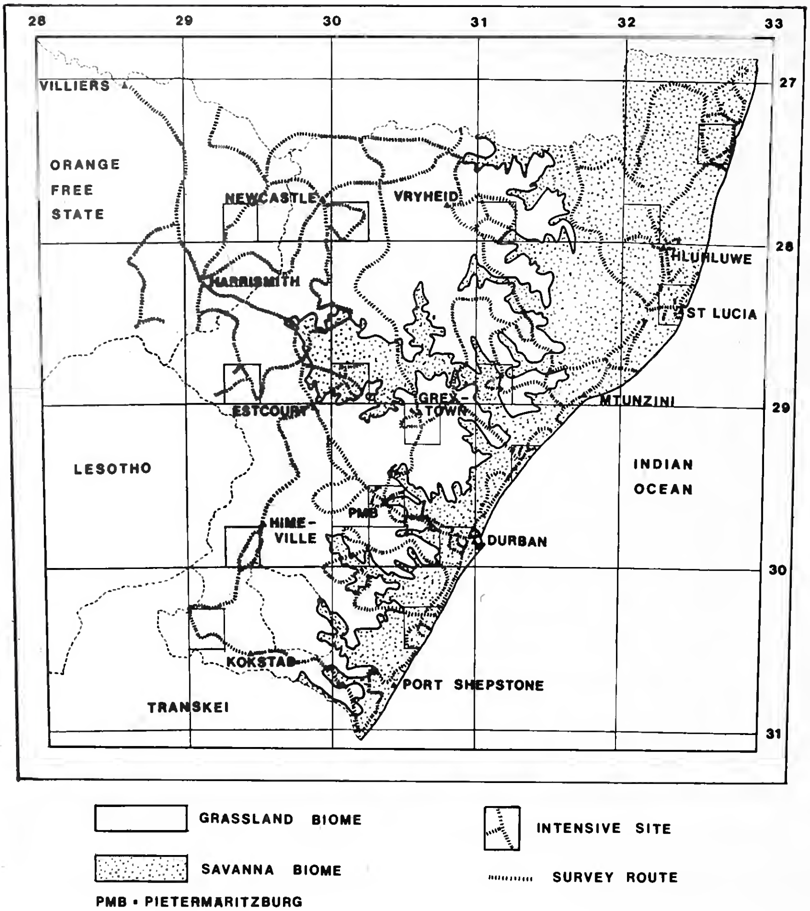

FIGURE 1.—The study area, Grassland and Savanna Biomes, intensive sites and survey routes.

roadside and veld habitats in the study area; to determine the pattern of alien woody invasion as a whole and for individual species; to attempt to relate distribution to environmental factors and to determine which are the most prominent and potentially important invaders.

The study area

The study area comprises Natal, including KwaZulu, which together occupy an area of 86 967 km² (Macdonald & Jarman 1985) and the extreme north-eastern Orange Free State which covers an area of approximately 17 400 km². It lies between latitudes 26° and 31°S and longitudes 28° and 33°E (Figure 1). From east to west the altitude rises rapidly, from sea level on the Indian Ocean coastline of Natal, in a series of terraces more or less parallel to the coast, to greater than 3 000 m on the Drakensberg escarpment. The western boundary of Natal is formed by the Drakensberg mountain range. The north-eastern Orange Free State lies to the west of the Drakensberg range at elevations of 1 500 m to 1 800 m on the highveld plateau.

The landscape of Natal is rugged and dissected by the valleys of 11 major rivers which arise in or adjacent to the province. The terrain is level in the north-eastern coastal region where numerous pans and lakes have developed.

Rainfall varies from 300 to 600 mm in some of the drier river valleys and in the north-eastern interior region to over 1 500 mm along the coast and on some of the peaks in the Drakensberg. Rain falls mostly in summer from November to March but on the coast up to one third of the rain falls during the winter period (Haigh & Wilhelmij 1973; Francis 1977).

The climate of the coastal belt and lowland interior is subtropical to tropical. From east to west, with rising altitude, the climate becomes progressively more temperate. The incidence of frost varies from light to moderate in the mistbelt (600–1 200 m) and moderate to severe in higher areas [Poynton (1972)—silvicultural map of the Republic of South Africa]. Snow falls most years at elevations of over 1 200 m and is a regular winter feature along the Drakensberg (Haigh & Wilhelmij 1973).

There are two major indigenous vegetation types or biomes, Savanna and Grassland, in the study area (Rutherford & Westfall 1986) (Figure 1). Twenty Acocks Veld Types (Acocks 1988) occur in the study area and have been grouped into six veld type categories for the purposes of this survey. These are temperate grassland, moist subtropical grassland, dry subtropical grassland, mistbelt grassland, all falling within the Grassland Biome; tropical bush and savanna, and tropical forest (Table 1 and Figure 2) are classified under the Savanna Biome.

TABLE 1.—Veld type categories in the study area and the equivalent Acocks Veld Type groupings and Veld Type numbers

Veld type category	Acocks Veld Type grouping	Acocks Veld Type No.
Temperate grassland	Pure grassveld types	48, 53, 54, 56, 57,58
Moist subtropical grassland	Temperate forest and scrub type	44
Dry subtropical grassland	False grassveld types	63, 64, 65, 66
Mistbelt grassland	Coastal tropical forest type	5
	Transitional forest and scrub type	45
Tropical bush and savanna	Tropical bush and savanna types	10, 11
	Karroid type	23
Tropical forest	Coastal tropical forest types	1, 3, 6
	Inland tropical forest type	8

Temperate grassland occupies the highest and coldest parts of the study area at elevations of 1 500 m to greater than 3 000 m. Rainfall ranges from 700–1 000 mm per annum. Moist subtropical grassland occurs on the eastern slopes and foothills of the Drakensberg from about 1 350 m to 2 150 m. Rainfall ranges from 750–1 500 mm per annum. Dry subtropical grassland lies at elevations of between 900 and 1 500 m and rainfall ranges from 600–1 000 mm per annum. This grassland has been invaded by woody thornveld species especially in its drier parts (Edwards 1967). Mistbelt grassland occupies rolling misty country at elevations of between 450 and 1 350 m. Rainfall ranges from 750–1 300 mm per annum. Tropical bush and savanna occupies the hot and dry river valleys and the north-eastern interior lowlands. Rainfall ranges from 300–800 mm per annum. Tropical forest is the major vegetation type of the warm and moist coastal belt. Rainfall ranges from 900–1 500 mm per annum. Little remains of the forest between Durban and the Transkei border to the south, but extensive patches exist on the north coast, particularly north of Lake St Lucia Estuary.

METHOD

Sampling method

The method used in this survey was basically the same as that used in the Transvaal (Henderson & Musil 1984)

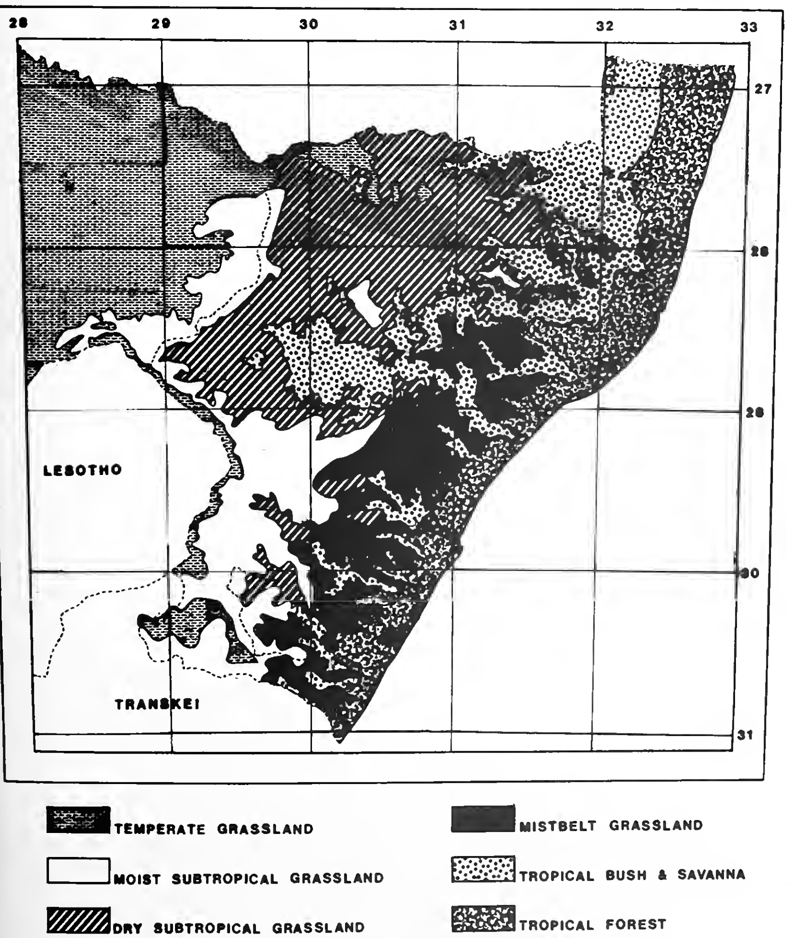

FIGURE 2.—The six broad veld type categories in the study area (after Acocks 1988).

but with minor changes to the abundance ratings (see next subheading). The presence and abundance of all naturalized alien trees, shrubs and conspicuous climbers were recorded for each veld type category, habitat type (roadsides and adjoining veld, and streambanks) and quarter degree square traversed by road. Although the objective of the survey was to record woody species, other large non-woody and succulent species were included rather than lose valuable information.

Recordings of roadside and veld invaders were made from a moving vehicle whereas recordings of streambank invaders were made at watercourse crossings. Abundance estimates of roadside and veld invaders were based on frequency of encounter within road transects of five to ten kilometres in length. Abundance estimates of streambank invaders were based on estimates at specific sites.

The width of road transects and length of watercourses scanned for invaders varied according to local conditions. Usually no more than 50 m of veld and 100 m of streambank habitat were scanned on either side of the road for invaders. Species occurring beyond these ranges and along watercourses which were not crossed were recorded as present in the given habitat type and veld type category but were not included within the formal recordings.

Although Henderson & Musil (1984) suggested the use of a single road transect length of ten kilometres, a variable transect length of between five and ten kilometres was found to be more practical. This applied particularly in the highly dissected veld type categories in the midlands and lowlands of Natal. In these regions it was often not possible to accommodate ten kilometre transects and where there was much invasion a shorter transect length proved to be more manageable. Since all road transects were plotted on maps the survey is easily repeatable despite the use of variable transect lengths.

Seventeen quarter degree squares were selected for more intensive surveying (Figure 1). These intensive sites were selected primarily to ensure that representative parts of each veld type category and geographical region in the study area were well sampled. They may also be used at a later date for a quick resurvey of the study area to assess any changes that may have taken place. In each of the seventeen sites abundance recordings of roadside and veld invaders were made along a total road length of approximately 30 km (six transects each five km long). Recordings were made at virtually all watercourse crossings. Herbarium specimens of all invader species which were flowering or fruiting, were collected.

Survey routes and road transects were plotted on 1:250 000 maps (general survey area) and 1:50 000 maps (intensive sites) before a field trip was undertaken. Wherever possible two or more road transects were plotted per quarter degree square. In most instances road transects were not contiguous but were separated by a distance of between five and ten kilometres. This approach was adopted mainly due to time considerations since abundance estimates along road transects can be very time-consuming depending on the intensity of invasion. In addition, it was necessary to have a breathing space between transects not only to avert eye strain but to free one's attention from the immediate roadside and to observe invasion further afield. Road transects along national roads and other routes with heavy traffic were kept to a minimum. All road transects to be sampled were plotted before a field trip was undertaken to ensure non-selective recording in the field. Recordings were made at most bridges over watercourses but some were omitted because of time constraints and traffic considerations.

Abundance ratings

Minor changes were made to the abundance ratings for roadside and veld habitats used in the Transvaal survey (Henderson & Musil 1984). The two ratings below the old rating '1' were removed. These ratings became obsolete as a result of the standardization of road transect length from 5–10 km. The abundance ratings for roadside and veld habitats and streambank habitats are given in Table 2.

Sampling level envisaged and achieved

The sampling level envisaged was at least 60% of the total quarter degree squares at an average of 33 km per square which was achieved in the Transvaal (Henderson & Musil 1984). The sampling level achieved in this survey was 87% (152 of the total 175 quarter degree squares) at an average of 38 km travelled per square. An average of

TABLE 2.—Abundance ratings

Rating	Roadsides and veld	No.*	Streambanks	Rating
9	A virtually continuous, almost pure stand	1000+	A virtually continuous, almost pure stand	7
8	The commonest species in a generally continuous tree or shrub layer	500–999	The commonest species in a generally continuous tree or shrub layer	6
7	Less abundant than above but greater than 20 individuals or groups per km	200–499		
6	10–20 individuals or groups per km	100–199		
5	5–10 individuals or groups per km	50–99	1 of the 2–3 commonest species in a generally continuous tree or shrub layer	5
4	2–5 individuals or groups per km	20–49	1 of the 4–6 commonest species in a generally continuous tree or shrub layer	4
3	± 1 individual or group per km	5–19	1 of the 7–11 commonest species in a generally continuous tree or shrub layer	3
2	Less abundant than above but more than 1 individual or group per 5 km	2–4	Less abundant than above but more than 1 individual present	2
1	1 plant or group per 5–10 km	1	1 plant in a sample	1

* Approximate numbers of individuals/groups per 10 km transect.

TABLE 3.—Sampling coverage in each veld type category, biome and the study area

Veld type category and biome	¼ degree squares	Road transects	Distance (km)*	Watercourse recordings
Savanna Biome	69	139	1 004	209
Tropical forest	40	80	556	94
Tropical bush and savanna	39	59	448	115
Grassland Biome	104	211	1 619	369
Temperate grassland	30	43	370	75
Dry subtropical grassland	40	72	510	173
Moist subtropical grassland	33	45	361	85
Mistbelt grassland	29	51	378	36
Study area	152	350	2 623	578

* This represents the distance along which abundance recordings were made. Total distance along which observations were made is approximately twice that given.

17 km of road transects were sampled per quarter degree square for abundance estimates of roadside and veld invaders.

The veld type coverage in terms of quarter degree squares and road transects sampled, kilometres travelled and watercourse recordings made, is given in Table 3.

Data treatment—formulae used

Frequency

The percentage frequency of occurrence of a species x in veld type category y was calculated as follows:

$$\text{frequency} = \frac{\text{no. of watercourse recordings/road transects in veld type y having species x}}{\text{total no. of watercourse recordings/road transects in veld type y}} \times 100$$

Prominence value

Prominence is used here in preference to the term Importance defined by Henderson & Musil (1984). The prominence value, which has been derived from Curtis' Importance Value (Mueller-Dombois & Ellenberg 1974), is a measure of the prominence (in terms of frequency and abundance) of a species in a vegetation category relative to all other species in the same category. Other aspects, such as rate of spread and difficulty of control, which should be taken into account when assessing species importance, are not included here, hence the preferred use of the term prominence.

In *streambank habitats* the prominence value for a species x in veld type category y was calculated as follows:

$$\text{prominence value} = \frac{\text{frequency of species x in veld type y scoring 5, 6 or 7}}{\text{sum frequency of all species in veld type y scoring 5, 6 or 7}} \times 100 + \frac{\text{frequency of species x in veld type y}}{\text{sum frequency of all species in veld type y}} \times 100$$

The selection of abundance rating 5 as the cut-off point is arbitrary but one at which a species can be regarded as locally prominent (see definition in Table 2). A formula using all abundance ratings would be preferable if each rating could be converted to an absolute value.

In *roadside and veld habitats* the prominence value for a species x in veld type category y was calculated as follows:

$$\text{prominence value} = \frac{\text{total abundance* of a species x in veld type y}}{\text{sum of the abundances* of all species in veld type y}} \times 100 + \frac{\text{frequency of a species x in veld type y}}{\text{sum frequency of all species in veld type y}} \times 100$$

The highest prominence values in a given category which add up to approximately 160 points out of a total of 200 are printed in bold in Tables 6 and 7. The cut-off point of 160 points is arbitrary but represents 80% of the summed prominence values.

Mean species abundance rating in roadside and veld habitats (see Table 7)

The mean abundance rating** of species x in veld type category y was calculated as follows:

$$\text{mean no. of individuals/groups per 10 km} = \frac{\text{total no. of individuals/groups of species x in veld type y}}{\text{total distance along which species x was rated in veld type y}} \times 10$$

Mean abundance of invaders per km in roadside and veld habitats (see Table 5 and Figure 5)

The mean abundance of invaders per kilometre in veld type category y/quarter degree square z was calculated as follows:

$$\text{mean abundance} = \frac{\text{total abundance* of all species in veld type y/quarter degree square z}}{\text{total kilometres rated for abundance estimates in veld type y/quarter degree square z}}$$

* each abundance rating was expressed in numbers of individuals/groups recorded per transect (see Table 2). To be both conservative and consistent the minimum number was used in each instance, e.g. an abundance rating of 5 over ten kilometres = 50 and an abundance rating of 5 over five kilometres = 25.

** mean no. of individuals/groups per 10 km converted to rating (see Table 2).

TABLE 4.—Streambank statistics for each veld type category, biome and the study area

Veld type category and biome	Total no. of spp.	Average no. of spp./crossing	Max. no. of spp./crossing	% crossings heavily invaded*	% crossings invaded**
Savanna Biome	66	3,3	13	16,9	82,3
Tropical forest	47	4,4	12	24,7	98,0
South of Durban	28	6,1	12	50,0	100,0
Tropical bush and savanna	44	2,3	13	11,3	70,0
Grassland Biome	52	2,0	7	29,3	81,3
Temperate grassland	15	1,3	4	24,0	85,3
Dry subtropical grassland	35	2,1	7	25,4	78,0
Moist subtropical grassland	26	1,6	7	36,9	76,5
Mistbelt grassland	34	3,9	7	41,7	100,0
Study area	90	2,4	13	24,9	81,7

* 1 or more species scored 5 or more. ** invaders present.

RESULTS

The survey yielded 130 naturalized alien species. These species are listed in the Appendix together with a further 50 species which were obtained from various literature and other sources. The distributions and high abundance areas of 32 of the most prominent species are given in Figures 6 & 7 (see Appendix).

The streambank habitat

The whole study area

Five hundred and seventy eight watercourse crossings were sampled in which 90 species were recorded, with up to 13 species in one sample (Table 4). Invaders were present at 81.7% of all crossings and 24,9% of all crossings were heavily invaded (Table 4).

Analysis according to veld type

More alien species were recorded in the Savanna Biome than in the Grassland Biome. The most species were recorded in tropical forest and the least in temperate grassland.

In the Grassland Biome there was a progressive increase in the severity of invasion in terms of percentage crossings heavily invaded with decreasing elevation from the montane region (temperate grassland) to the mistbelt. The rivers in mistbelt grassland and tropical forest south of Durban were the most invaded in terms of percentage crossings heavily invaded and percentage crossings invaded. The rivers of tropical bush and savanna were the least invaded (Table 4).

Analysis according to species

Frequency

Only eight species were recorded at 10% or more crossings in the whole study area (Table 6). *Acacia dealbata* and *Salix babylonica* were the most frequently encountered species.

In the Grassland Biome the most frequently recorded species were *Acacia dealbata, Salix babylonica* and *Acacia mearnsii. Ricinus communis* was by far the most frequent invader in the Savanna Biome followed by *Psidium guajava, Chromolaena odorata, Solanum mauritianum* and *Melia azedarach* which were almost equally frequent.

The highest percentage frequency recorded was 73% for *Salix babylonica* in temperate grassland.

TABLE 5.—Statistics for roadside and veld habitats in each veld type category, biome and the study area

Veld type category and biome	Total no. of spp.	Average no. of spp./¼° sq.	Max. no. of spp./¼° sq.	% transects invaded	% transects heavily invaded*	Mean abundance** (nos of individuals/ groups per km)
Savanna biome	79	9,9	44	95,7	36,7	17,0
Tropical forest	68	13,6	44	95,0	55,0	27,5
Tropical bush and savanna	40	6,2	13	96,6	11,9	4,0
Grassland Biome	81	6,9	36	92,4	26,5	7,4
Temperate grassland	26	4,3	12	79,1	0,0	0,5
Dry subtropical grassland	43	6,4	16	91,7	12,5	2,0
Moist subtropical grassland	31	5,9	11	97,8	44,4	11,1
Mistbelt grassland	60	11,4	36	100,0	52,9	18,1
Study area	116	9,5	44	93,7	30,6	11,1

* 1 or more species scored 5 or more. ** See data treatment—formulae used.

Prominence

The most prominent invader in the study area was *Acacia dealbata*, followed by *A. mearnsii* and *Salix babylonica* (Table 6). *A. dealbata* was very common to abundant (i.e. scored a 5, 6 or 7) at 10% (60/578) of all river crossings in the study area. *A. mearnsii* and *Salix babylonica* were very common to abundant at 4% (24/578) and 3% (19/578) respectively (Table 6).

In the Grassland Biome *A. dealbata* was by far the most prominent invader followed by *Salix babylonica* and *A. mearnsii*. *Salix babylonica* was prominent in temperate grassland, *A. dealbata* most prominent in moist subtropical grassland and both *Acacia* spp. were prominent in dry subtropical grassland and mistbelt grassland.

In the Savanna Biome *Chromolaena odorata, Lantana camara* and *Ricinus communis* were the most prominent invaders. The first two species were most prominent in tropical forest and although they were not the most frequently recorded species they formed dense stands more often than did any other species. *Ricinus communis* rarely formed dense stands, its prominence being largely attributable to its high percentage frequency. *Sesbania punicea* and *Melia azedarach* were the most prominent species in tropical bush and savanna.

Roadside and veld habitats

The whole study area

One hundred and fifty two quarter degree squares and 350 road transects were sampled in which 116 species were recorded. Up to 44 species were recorded per quarter degree square. Invaders were recorded in 93,7% of all transects sampled and 30,6% of all transects were heavily invaded (see Table 5).

Analysis according to veld type

Tropical forest was the most heavily invaded in terms of species diversity and abundance of invaders (Table 5). Mistbelt grassland was the next most heavily invaded. Within these veld type categories the Pietermaritzburg, Durban and particularly the south coast were the most heavily invaded (Figures 4 & 5). Temperate grassland was the least invaded.

Analysis according to species

Frequency

The most frequently recorded species in the study area were *Melia azedarach, Acacia mearnsii, Solanum mauritianum* and *Ricinus communis* (Table 7). Only about 14 spp. were recorded in more than 10% of all transects.

The most frequently recorded invader in the Grassland Biome was *Acacia mearnsii*, followed by *A. dealbata, Eucalyptus* spp., *Solanum mauritianum, Melia azedarach, Prunus persica* and *Rubus* spp. (mainly *R. cuneifolius*).

In the Savanna Biome *Ricinus communis, Melia azedarach* and *Psidium guajava* were the most frequently recorded invaders, followed by *Solanum mauritianum, Chromolaena odorata* and *Lantana camara. Opuntia ficus-indica* was the most frequent invader in tropical bush and savanna.

Prominence

Chromolaena odorata, despite the fact that it was almost entirely confined to the coastal belt, scored the highest prominence value in the study area (Table 7). It had the highest mean abundance rating (7) of all species in the study area (Table 7). The next most prominent species in order (mean abundance ratings in brackets) were *Solanum mauritianum* (5), *Psidium guajava* (5), *Rubus* spp., mainly *R. cuneifolius* (5), *Acacia mearnsii* (4) and *Lantana camara* (5).

In the Grassland Biome *Rubus* spp., *Solanum mauritianum* and *Acacia mearnsii* were the most prominent species. In the Savanna Biome *Chromolaena odorata, Psidium guajava* and *Lantana camara* were the most prominent species.

Acacia dealbata deserves mention as the second most prominent invader after *Rubus* spp. in moist subtropical grassland. *Opuntia ficus-indica* rated second most prominent after *Lantana camara* in bush and savanna. *Melia azedarach* rated second most prominent after *Acacia mearnsii* in dry subtropical grassland.

Patterns of invasion

Most invasion in terms of species diversity and abundance of invaders was recorded in the coastal belt and adjacent midlands. Within this zone most invasion occurs in and around towns and cities particularly Pietermaritzburg and Durban. The coastal belt is heavily invaded south of Durban as well as in the north around Mtunzini and Lake St Lucia (Figure 5). The north-eastern coastal plains and bushveld north of Lake St Lucia have little invasion except along the perennial rivers such as the Pongola.

A comparison of Figures 3 and 4, indicating the severity of invasion in streambank and roadside and veld habitats respectively, shows similar patterns except that in the uplands there is more severe invasion of the streambank habitat than of roadside and veld habitats. This pattern of streambank invasion in the uplands is mainly the result of *Acacia dealbata* invasions (Figure 6A) and, to a lesser extent, that of *Salix babylonica* (Figure 7K).

DISCUSSION

Sampling

As mentioned previously (Henderson & Musil 1984) the sampling method has its limitations, such as the undersampling of certain habitats which are inaccessible by road, and the less distinctive species. The results reflect only the situation along road verges, which are highly disturbed sites, and a small strip of veld and watercourse visible from the road. Despite these limitations the method has proved successful and economical in obtaining information that otherwise would be unobtainable.

One recommendation with regard to the abundance ratings is that the seven point scale used for streambank habitats be revised or replaced with a cover-abundance scale such as used in the Braun-Blanquet method of vegetation analysis (see Mueller-Dombois & Ellenberg 1974). The present scale is unsatisfactory as it cannot cope

TABLE 6.—Alien species occurring in streambank habitats

Veld type category and biome	Savanna Biome									Grassland Biome															Total study area		
	Tropical forest			Tropical bush & savanna			Total			Temperate grassland			Dry sub-tropical grassland			Moist sub-tropical grassland			Mistbelt grassland			Total					
No. watercourse crossings	94			115			209			75			173			85			36			369			578		
	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P
Acacia																											
dealbata				7,8		3,4	4,3		1,4	16,0	5,3	**32,4**	33,7	14,5	**58,1**	51,8	28,2	**94,8**	58,3	19,4	**45,8**	36,6	16,3	**62,2**	24,9	10,3	**43,0**
decurrens													2,3		1,1	2,4		1,5				1,6		0,8	1,0		0,4
longifolia				0,9		0,4	0,5		0,2							1,2		0,7	2,8		0,7	0,5		0,3	0,5		0,2
mearnsii	4,3		1,0	7,8		3,4	6,2		2,0	1,3		1,0	38,4	9,3	**45,4**	9,4	2,4	**11,1**	63,9	16,7	**43,0**	26,6	6,5	**30,9**	19,2	4,2	**21,4**
melanoxylon													*			*			*			*			*		
podalyriifolia																1,2		0,7				0,3		0,2	0,2		0,1
Agave																											
americana				1,7		0,7	1,0		0,3				1,2		0,6							0,5		0,3	0,7		0,3
sisalana				2,6		1,1	1,4		0,5																0,5		0,2
sp.	*						*																		*		
Ageratina																											
adenophora																			*			*			*		
Arundo																											
donax	18,0	3,2	**13,8**	6,1		2,7	11,5	1,4	**10,1**	*			1,7		0,8				*			0,8		0,4	4,7	0,5	3,6
Bambusa																											
balcooa	8,5		1,9				3,8		1,2				*						*			*			1,4		0,6
Bambuseae sp.																			*			*			*		
Bambuseae sp.	1,1		0,3				0,5		0,2																0,2		0,1
Caesalpinia																											
decapetala	10,6		2,4	7,0	0,9	**10,0**	8,6	0,5	5,1				1,7	0,6	2,6				13,9		3,7	2,2	0,3	1,9	4,5	0,3	2,9
Canna																											
indica	*						*																		*		
Cardiospermum																											
grandiflorum	*			0,9		0,4	0,5		0,2																0,2		0,1
Carica																											
papaya	1,1		0,3				0,5		0,2																0,2		0,1
Cassia																											
bicapsularis	5,3		1,2	1,7		0,7	3,3		1,1																1,2		0,5
coluteoides				*			*																		*		
didymobotrya	28,7	3,2	**16,2**	9,6	0,9	**11,1**	18,2	1,9	**14,6**										2,8		0,7	0,3		0,2	6,7	0,7	**5,0**
floribunda													1,7		0,8							0,8		0,4	0,5		0,2
hirsuta	*						*																		*		
sp.	1,1		0,3				0,5		0,2																0,2		0,1

F = % frequency of occurrence; I = % crossings heavily invaded; P = prominence value; * = species occurring in the given category but not included in a formal recording at a watercourse crossing; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 6.—Alien species occurring in streambank habitats (continued)

Veld type category and biome	Savanna Biome									Grassland Biome																		Total study area		
	Tropical forest			Tropical bush & savanna			Total			Temperate grassland			Dry sub-tropical grassland			Moist sub-tropical grassland			Mistbelt grassland			Total								
No. watercourse crossings	94			115			209			75			173			85			36			369			578		
	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P
Casuarina																											
sp. cf. *cunninghamiana*													*									*			*		
Cereus																											
peruvianus				0,9		0,4	0,5		0,2																0,2		0,1
Cestrum																											
laevigatum				0,9		0,4	0,5		0,2																0,2		0,1
Chromolaena																											
odorata	45,7	11,7	**45,6**	7,8	0,9	**10,3**	24,9	5,7	**34,1**										*			*			9,0	2,1	**10,4**
Cinnamomum																											
camphora	*						*																		*		
Cryptomeria																											
japonica																			*			*			*		
Cupressus																											
sp. cf. *arizonica*																*						*			*		
spp.																			*			*			*		
Eucalyptus																											
camaldulensis	1,1		0,3				0,5		0,2																0,2		0,1
robusta	1,1		0,3				0,5		0,2																0,2		0,1
spp.	8,5		1,9	3,5		1,5	5,7		1,9	*			7,6	1,7	**8,6**	2,4		1,5	11,1		2,9	4,9	0,8	4,6	5,4	0,5	3,9
Gleditsia																											
triacanthos										1,3		1,0	1,2		0,6	*						0,8		0,4	0,5		0,2
Hedychium																											
coronarium	*						*												*			*			*		
flavum	*						*																		*		
Ipomoea																											
alba				0,9		0,4	0,5		0,2																0,2		0,1
congesta/purpurea	10,6		2,4	0,9		0,4	5,3		1,7				1,2		0,6							0,5		0,3	2,2		0,9
fistulosa	*			*			*																		*		
Jacaranda																											
mimosifolia	*			1,7		0,7	1,0		0,3										2,8		0,7	0,3		0,2	0,5		0,2
Lantana																											
camara	27,7	8,5	**32,1**	7,0	1,7	**16,1**	16,3	4,8	**27,2**				4,1	0,6	3,7				5,6		1,5	2,4	0,3	2,0	7,4	1,9	**9,1**
Leucaena																											
leucocephala				1,7		0,7	1,0		0,3																0,3		0,1

F = % frequency of occurrence; I = % crossings heavily invaded; P = prominence value; * = species occurring in the given category but not included in a formal recording at a watercourse crossing; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 6.—Alien species occurring in streambank habitats (continued)

Veld type category and biome	Savanna Biome									Grassland Biome															Total study area		
	Tropical forest			Tropical bush & savanna			Total			Temperate grassland			Dry sub-tropical grassland			Moist sub-tropical grassland			Mistbelt grassland			Total					
No. watercourse crossings	94			115			209			75			173			85			36			369			578		
	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P
Mangifera																											
indica	4,3		1,0	0,9		0,4	2,4		0,8																0,9		0,4
Manihot																											
sp.	1,1		0,3				0,5		0,2																0,2		0,1
Melia																											
azedarach	42,6		**9,7**	39,1	2,6	**37,1**	23,0	1,4	**13,9**				19,8		**9,6**	1,2		0,7	22,2		**5,9**	11,7		6,0	15,7	0,5	**8,2**
Metasequoia																											
glyptostroboides													0,6		0,3				*			0,3		0,2	0,2		0,1
Monstera																											
deliciosa	*						*																		*		
Montanoa																											
hibiscifolia	4,3		1,0				1,9		0,6																0,7		0,3
Morus																											
alba	5,3		1,2	7,0	0,9	**10,0**	6,2	0,5	4,3				3,5		1,7	1,2		0,7	8,3		2,2	2,7		1,2	4,0	0,2	2,3
Musa																											
sp.	3,2		0,7	*			1,4		0,5																0,5		0,2
Nicotiana																											
glauca				2,6		1,1	1,4		0,5																0,5		0,2
Opuntia																											
ficus-indica	1,1		0,3	3,5		1,5	2,4		0,8				2,3		1,1	1,2		0,7				1,1		0,7	1,6		0,7
stricta				0,9		0,4	0,5		0,2				0,6		0,3							0,3		0,2	0,3		0,1
Pandanus																											
sp.	*						*																		*		
Pennisetum																											
purpureum	10,6	2,1	**8,8**				4,8	1,0	6,1																1,7	0,3	1,7
Pinus																											
elliottii/taeda																			*			*			*		
patula													0,6		0,3	1,2		0,7				0,5		0,3	0,3		0,1
spp.	*						*									1,2		0,7	*			0,3		0,2	0,2		0,1
Populus																											
× *canescens*				2,6		1,1	1,4		0,5	8,0	1,3	11,1	9,9	2,9	**13,2**	3,5		2,2	2,8	2,8	5,1	7,3	1,9	**8,8**	5,2	1,2	**6,0**
deltoides				0,9		0,4	0,5		0,2	*			2,9	0,6	3,1	*			13,9		3,7	2,7	0,3	2,2	1,9	0,2	1,4
nigra										1,3		1,0	0,6		0,3	1,2		0,7				0,8		0,4	0,5		0,2
Prunus																											
persica				4,3		1,9	2,4		0,8	5,3		4,1	8,7		4.2	11,8		7,3	33,3		**8,8**	11,1		5,7	8,0		3,4

F = % frequency of occurrence; I = % crossings heavily invaded; P = prominence value; * = species occurring in the given category but not included in a formal recording at a watercourse crossing; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 6.—Alien species occurring in streambank habitats (continued)

Veld type category and biome	Savanna Biome									Grassland Biome																Total study area		
	Tropical forest			Tropical bush & savanna			Total			Temperate grassland			Dry sub-tropical grassland			Moist sub-tropical grassland			Mistbelt grassland			Total					
No. watercourse crossings	94			115			209			75			173			85			36			369			578		
	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P	F	I	P
Psidium																											
guajava	52,1	1,1	**15,2**	3,5		1,5	25,4	0,5	**10,6**				2,3		1,1				5,6		1,5	1,6		0,8	10,2	0,2	**5,0**
Punica																											
granatum													0,6		0,3							0,3		0,2	0,2		0,1
Pyracantha																											
angustifolia				1,7		0,7	1,0		0,3	5,3		4,1	1,7		0,8	*						1,9		1,0	1,6		0,7
Quercus																											
robur																• 1,2		0,7				0,3		0,2	0,2		0,1
Ricinus																											
communis	61,7	2,1	**20,4**	41,7	0,9	**25,2**	50,7	1,4	**23,0**				5,2		2,5				8,3		2,2	3,3		1,7	20,4	0,5	**10,2**
Rosa																											
eglanteria										2,7		2,1										0,5		0,3	0,3		0,1
odorata	1,1		0,3				0,5		0,2																0,2		0,1
Rubus																											
affinis	2,1		0,5				1,0		0,3										2,8		0,7	0,3		0,2	0,5		0,2
sp. cf. *cuneifolius*				0,9		0,4	0,5		0,2				1,2		0,6	9,4	1,2	8,5	30,6	8,3	**21,1**	5,7	1,1	5,8	3,8	0,7	3,8
spp.													0,6		0,3				2,8		0,7	0,5		0,3	0,3		0,1
Saccharum																											
officinarum	7,4		1,7	0,9		0,4	3,8		1,2																1,4		0,6
Salix																											
babylonica	1,1		0,3	6,1		2,6	3,8		1,2	73,3	14,7	**112,6**	19,8	1,7	**14,5**	45,9	7,1	**44,1**	16,7		4,4	36,3	5,1	**32,2**	24,6	3,3	**20,8**
caprea																3,5		2,2				0,8		0,4	0,5		0,2
lasiandra				0,9		0,4	0,5		0,2	10,7	4,0	**23,4**	7,0		3,4	7,1	5,9	**17,5**	2,8	2,8	5,1	7,3	2,2	**9,6**	4,8	1,4	6,4
Sambucus																											
canadensis																			2,8	2,8	5,1	0,3	0,3	1,0	0,2	0,2	0,7
Schinus																											
terebinthifolius	7,4	1,1	5,0				3,3	0,5	3,4																1,2	0,2	1,1
Sesbania																											
punicea	18,1		4,1	20,0	4,3	**41,6**	19,1	2,4	**17,2**	2,7	1,3	7,0	14,5	2,3	**13,7**	*			**5,6**	**2,8**	**5,9**	7,9	1,6	**8,3**	11,9	1,9	**11,0**
Solanum																											
mauritianum	34,0		7,7	15,7		6,9	23,9		**7,8**				8,1	0,6	5,7	4,7		2,9	58,3	8,3	**28,4**	10,6	0,8	7,6	15,4	0,5	**8,1**
Tithonia																											
diversifolia	5,3		1,2				2,4		0,8																0,9		0,4
Yucca																											
sp. cf. *aloifolia*				0,9		0,4	0,5		0,2																0,2		0,1

F = % frequency of occurrence; I = % crossings heavily invaded; P = prominence value; * = species occurring in the given category but not included in a formal recording at a watercourse crossing; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 7.—Alien species occurring in roadside and veld habitats

Veld type category and biome	Savanna Biome									Grassland Biome															Total study area		
	Tropical forest			Tropical bush & savanna			Total			Temperate grassland			Dry sub-tropical grassland			Moist sub-tropical grassland			Mistbelt grassland			Total					
No. road transects	80			59			139			43			72			45			51			211			350		
	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P
Acacia																											
dealbata										48,8	2,0	**53,9**	27,8	3,0	**20,0**	73,3	4,0	**40,0**	19,6	3,0	4,8	39,8	3,0	**19,0**	24,0	3,0	**9,0**
decurrens										4,7	1,0	3,1	5,6	3,0	3,2	11,1	3,0	3,8	*			5,2	3,0	1,7	3,1	3,0	0,8
longifolia	3,8	1,0	0,6				2,2	1,0	0,4				1,4	2,0	0,5				7,8	2,0	1,3	2,4	2,0	0,7	2,3	2,0	0,5
mearnsii	18,8	3,0	3,2	11,9	3,0	5,5	15,8	3,0	**3,5**	7,0	3,0	**11,1**	62,5	3,0	**50,1**	55,6	4,0	**31,8**	96,1	4,0	**30,2**	57,8	4,0	**31,5**	41,1	4,0	**16,4**
melanoxylon	*						*			2,3	1,0	1,5	*			8,9	4,0	5,1	5,9	3,0	1,3	3,8	3,0	2,0	2,3	3,0	0,9
podalyriifolia	5,0	2,0	0,8				2,9	2,0	0,6				1,4	1,0	0,5	*			2,0	2,0	0,3	0,9	1,0	0,2	1,7	2,0	0,4
Agave																											
americana				13,6	2,0	4,5	5,8	2,0	1,2	4,7	1,0	3,1	12,5	1,0	4,4	*			*			5,2	1,0	1,4	5,4	1,0	1,3
sisalana	10,0	2,0	1,6	18,6	2,0	**7,6**	13,7	2,0	2,9										3,9	1,0	0,7	0,9	1,0	0,3	6,0	2,0	1,5
sp.	1,3	2,0	0,2				0,7	2,0	0,1																0,3	2,0	0,1
Ageratina																											
adenophora																			*			*			*		
Ailanthus																											
altissima	*						*												*			*			*		
Antigonon																											
leptopus	1,3	4,0	0,3				0,7	4,0	0,2																0,3	4,0	0,1
Arundo																											
donax	10,0	2,0	1,6	*			5,8	2,0	1,2				1,4	2,0	0,6				2,0	1,0	0,3	0,9	1,0	0,3	2,9	2,0	0,7
Bambusa																											
balcooa	2,5	2,0	0,4				1,4	2,0	0,3										2,0	1,0	0,3	0,5	1,0	0,1	0,9	2,0	0,2
Bambuseae																											
sp.	1,3	2,0	0,2				0,7	2,0	0,1																0,3	2,0	0,1
Bauhinia																											
variegata	*						*												*			*			*		
Caesalpinia																											
decapetala	13,8	3,0	2,3	6,8	3,0	3,2	10,8	3,0	2,4				1,4	3,0	0,9	2,2	1,0	0,6	23,5	3,0	4,4	6,6	3,0	2,1	8,3	3,0	2,3
Canna																											
indica	*						*												*			*			*		
Cardiospermum																											
grandiflorum	*						*												*			*			*		
Carica																											
papaya	1,3	2,0	0,2				0,7	2,0	0,1																0,3	2,0	0,1
Cassia																											
bicapsularis	5,0	2,0	0,8	1,7	2,0	0,6	3,6	2,0	0,7																1,4	2,0	0,3

F = % frequency of occurrence; A = mean abundance rating; P = prominence value; * = species occurring in the given category but not included in a formal recording in a road transect; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 7.—Alien species occurring in roadside and veld habitats (continued)

Veld type category and biome	Savanna Biome									Grassland Biome															Total study area		
	Tropical forest			Tropical bush & savanna			Total			Temperate grassland			Dry sub-tropical grassland			Moist sub-tropical grassland			Mistbelt grassland			Total					
No. road transects	80			59			139			43			72			45			51			211			350		
	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P
Cassia																											
coluteoides				3,4	1,0	1,1	1,4	1,0	0,3																0,6	1,0	0,1
didymobotrya	25,0	4,0	**6,5**	8,5	3,0	4,3	18,0	4,0	**6,0**				2,8	1,0	0,9				13,7	2,0	2,3	4,3	2,0	1,2	9,7	4,0	3,8
floribunda													2,8	2,0	0,9				*			0,9	2,0	0,2	0,6	2,0	0,1
hirsuta	3,8	2,0	0,6				2,2	2,0	0,5																0,9	2,0	0,2
sp.	1,3	2,0	0,2	1,7	1,0	0,5	1,4	1,0	0,3																0,6	1,0	0,1
Casuarina																											
equisetifolia	2,5	2,0	0,4				1,4	2,0	0,3																0,6	2,0	0,1
sp. cf. *cunninghamiana*																			*			*			*		
Cedrus																											
deodara										*												*			*		
Cereus																											
peruvianus				1,7	1,0	0,5	0,7	1,0	0,1																0,3	1,0	0,1
Cestrum																											
aurantiacum																			*			*			*		
laevigatum	1,3	4,0	0,3				0,7	4,0	0,2										*			*			0,3	4,0	0,1
Chromolaena																											
odorata	56,3	7,0	**49,6**	8,5	6,0	**17,3**	36,0	7,0	**45,2**										9,8	3,0	2,6	2,4	3,0	1,2	15,7	7,0	**26,3**
Cinnamomum																											
camphora	*						*																		*		
Cotoneaster																											
franchetii													*									*			*		
spp.				*			*									2,2	1,0	0,6	*			0,5	1,0	0,1	0,3	1,0	0,1
Crotalaria																											
agatiflora																			*			*			*		
Cupressus																											
sp. cf. *arizonica*																*						*			*		
spp.										2,3	1,0	1,5							*			0,5	1,0	0,1	0,3	1,0	0,1
Cytisus																											
scoparius																2,2	2,0	0,7				0,5	2,0	0,1	0,3	2,0	0,1
Dahlia																											
imperialis																			*			*			*		
Delonix																											
regia	1,3	2,0	0,2				0,7	2,0	0,1																0,3	2,0	0,1

F = % frequency of occurrence; A = mean abundance rating; P = prominence value; * = species occurring in the given category but not included in a formal recording in a road transect; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 7.—Alien species occurring in roadside and veld habitats (continued)

Veld type category and biome	Savanna Biome									Grassland Biome																	Total study area		
	Tropical forest			Tropical bush & savanna			Total			Temperate grassland			Dry sub-tropical grassland			Moist sub-tropical grassland			Mistbelt grassland			Total							
No. road transects	80			59			139			43			72			45			51			211					350		
	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P			F	A	P
Eucalyptus																													
cinerea																2,2	1,0	0,6	2,0	2,0	0,3	0,9	1,0	0,3			0,6	1,0	0,1
spp.	22,5	3,0	3,7	3,4	1,0	1,1	14,4	2,0	3,0	30,2	1,0	**25,2**	41,7	2,0	**16,8**	22,2	3,0	7,3	43,1	3,0	**8,3**	35,5	2,0	**10,8**			27,1	2,0	**6,9**
Euphorbia																													
pulcherrima	*						*												*			*					*		
Gleditsia																													
triacanthos										*			1,4	2,0	0,6				*			0,5	2,0	0,1			0,3	2,0	0,1
Grevillea																													
robusta	1,3	2,0	0,2				0,7	2,0	0,1										2,0	1,0	0,3	0,5	1,0	0,1			0,6	1,0	0,1
Hedychium																													
coronarium	*						*												*			*					*		
flavum	*						*												*			*					*		
Hylocereus																													
sp.	*						*																				*		
Ipomoea																													
alba	*						*																				*		
congesta/purpurea	3,8	3,0	0,7	3,4	2,0	1,1	3,6	3,0	0,8																		1,4	3,0	0,4
fistulosa	8,8	1,0	1,4	5,1	2,0	1,8	7,2	2,0	1,5																		2,8	2,0	0,7
Jacaranda																													
mimosifolia	7,5	2,0	1,2	10,2	1,0	3,3	8,6	2,0	1,8				11,1	2,0	4,3				13,7	2,0	2,3	7,1	2,0	2,0			7,7	2,0	1,8
Jatropha																													
sp.				*			*																				*		
Lagerstroemia																													
indica	*						*																				*		
Lantana																													
camara	47,5	6,0	**21,2**	16,9	5,0	**40,4**	34,5	5,0	**22,8**				5,6	3,0	3,2				25,5	4,0	**9,0**	8,1	4,0	**5,0**			18,6	5,0	**14,9**
Leucaena																													
leucocephala	3,8	3,0	0,7				2,2	3,0	0,6																		0,8	3,0	0,3
Mangifera																													
indica	7,5	1,0	1,2				4,3	1,0	0,9																		1,7	1,0	0,4
Manihot																													
sp.	1,3	1,0	0,2				0,7	1,0	0,1										*			*					0,3	1,0	0,1
Melia																													
azedarach	62,5	3,0	**11,3**	54,2	2,0	**20,7**	59,0	3,0	**13,3**	*			52,8	2,0	**24,9**	8,9	1,0	2,6	54,9	3,0	**10,1**	33,2	2,0	**10,2**			43,4	3,0	**11,7**
Montanoa																													
hibiscifolia	11,3	4,0	2,9				6,5	4,0	2,3										*								2,5	4,0	1,2

F = % frequency of occurrence; A = mean abundance rating; P = prominence value; * = species occurring in the given category but not included in a formal recording in a road transect; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 7.—Alien species occurring in roadside and veld habitats (continued)

Veld type category and biome	Savanna Biome									Grassland Biome																				
	Tropical forest			Tropical bush & savanna			Total			Temperate grassland			Dry sub-tropical grassland			Moist sub-tropical grassland			Mistbelt grassland			Total			Total study area		
No. road transects	80			59			139			43			72			45			51			211			350		
	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P
Morus																											
alba	7,5	3,0	1,2	5,1	2,0	1,6	6,5	2,0	1,4				2,8	1,0	0,9				2,0	3,0	0,4	1,4	2,0	0,4	3,4	2,0	0,8
Nerium																											
oleander													1,4	2,0	0,6							0,5	2,0	0,1	0,3	2,0	0,1
Nicotiana																											
glauca				1,7	2,0	0,5	0,7	2,0	0,1																0,3	2,0	0,1
Opuntia																											
ficus-indica	6,3	2,0	1,0	61,0	3,0	**28,1**	29,5	3,0	**6,7**	11,6	1,0	8,8	22,2	1,0	**8,3**	4,4	2,0	1,3	7,8	1,0	1,3	12,8	1,0	3,5	19,4	2,0	5,1
spinulifera				1,7	2,0	0,5	0,7	2,0	0,1				2,8	1,0	0,9	2,2	1,0	0,6				1,4	1,0	0,4	1,1	1,0	0,3
stricta				13,6	3,0	5,7	5,8	3,0	1,3				*									*			2,3	3,0	0,6
vulgaris	10,0	1,0	1,5	1,7	2,0	0,5	6,5	1,0	1,3				1,4	2,0	0,5							0,5	2,0	0,1	2,8	1,0	0,7
Pandanus																											
sp.	*						*																		*		
Passiflora																											
edulis	2,5	2,0	0,4				1,4	2,0	0,3																0,6	2,0	0,1
foetida	*						*																		*		
Pennisetum																											
purpureum	13,8	3,0	2,3	*			7,9	3,0	1,7				1,4	1,0	0,5				7,8	1,0	1,3	2,4	1,0	0,7	4,6	2,0	1,1
Pereskia																											
aculeata	1,3	2,0	0,2				0,7	2,0	0,1																0,3	2,0	0,1
Pinus																											
canariensis	5,0	2,0	0,8				3,6	2,0	0,7																1,1	2,0	0,3
elliottii/taeda	17,5	4,0	**4,6**	*			10,1	4,0	**3,7**	2,3	1,0	1,5	*			2,2	1,0	0,6	7,8	2,0	1,3	2,8	2,0	0,8	5,7	4,0	1,7
patula				1,7	2,0	0,5	0,7	2,0	0,1	2,3	1,0	1,5	2,8	2,0	1,3	22,2	2,0	7,1	2,0	4,0	0,6	6,6	3,0	2,2	4,3	3,0	1,2
sp. cf. *uncinata*																*						*			*		
spp.				1,7	1,0	0,5	0,7	1,0	0,1				1,4	1,0	0,5	*			2,0	4,0	0,5	0,9	3,0	0,3	0,9	3,0	0,2
Populus																											
× *canescens*	*			1,7	2,0	0,5	0,7	2,0	0,1	14,0	1,0	9,4	12,5	1,0	4,3	2,2	1,0	0,6	*			7,6	1,0	2,1	4,8	1,0	1,1
deltoides										*			*									*			*		
nigra										2,3	2,0	2,0										0,5	2,0	0,1	0,3	2,0	0,1
Prunus																											
armeniaca										2,3	1,0	1,5				*						0,5	1,0	0,1	0,3	1,0	0,1
persica	1,3	2,0	0,2	6,8	2,0	2,3	3,6	2,0	0,7	37,2	2,0	**36,2**	22,2	2,0	**8,9**	37,8	2,0	**11,7**	41,2	2,0	**7,2**	33,2	2,0	**9,7**	21,4	2,0	**5,3**
Psidium																											
guajava	73,8	6,0	**35,2**	20,3	3,0	**8,6**	51,1	5,0	**31,5**				8,3	3,0	**7,0**				31,4	3,0	6,9	10,4	3,0	4,2	26,6	5,0	**19,4**

F = % frequency of occurrence; A = mean abundance rating; P = prominence value; * = species occurring in the given category but not included in a formal recording in a road transect; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 7.—Alien species occurring in roadside and veld habitats (continued)

Veld type category and biome	Savanna Biome									Grassland Biome															Total study area		
	Tropical forest			Tropical bush & savanna			Total			Temperate grassland			Dry sub-tropical grassland			Moist sub-tropical grassland			Mistbelt grassland			Total					
No. road transects	80			59			139			43			72			45			51			211			350		
	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P
Punica																											
granatum													1,4	1,0	0,5							0,5	1,0	0,1	0,3	1,0	0,1
Pyracantha																											
angustifolia										23,3	1,0	**18,1**	5,6	1,0	2,0	4,4	1,0	1,3	2,0	1,0	0,3	8,1	1,0	2,2	4,8	1,0	1,1
fortuneana										*						*						*			*		
rogersiana										2,3	1,0	1,5										0,5	1,0	0,1	0,3	1,0	0,1
sp. cf. *coccinea*	*						*									*						*			*		
Quercus																											
robur																*			2,0	2,0	0,3	0,5	2,0	0,1	0,3	2,0	0,1
Ricinus																											
communis	72,5	3,0	**14,0**	47,5	3,0	**26,8**	61,9	3,0	**15,8**				9,7	2,0	**4,5**				33,3	2,0	5,7	11,4	2,0	3,3	31,4	3,0	**9,6**
Robinia																											
pseudo-acacia										*			1,4	2,0	0,5				2,0	1,0	0,3	0,9	1,0	0,2	0,6	1,0	0,1
Rosa																											
eglanteria										16,3	2,0	**16,8**				8,9	2,0	2,8				5,2	2,0	1,5	3,1	2,0	0,8
odorata																			*			*			*		
Rubus																											
affinis													6,9	1,0	2,3	*			2,0	1,0	0,3	2,8	1,0	0,8	1,7	1,0	0,4
sp. cf. *cuneifolius*				1,7	2,0	0,6	0,7	2,0	0,1	2,3	1,0	1,5	2,8	3,0	1,4	57,8	5,0	**53,9**	64,7	6,0	**47,3**	28,9	5,0	**40,9**	17,7	5,0	**17,8**
Saccharum																											
officinarum	5,0	3,0	1,0				2,9	3,0	0,7																1,1	3,0	0,3
Schinus																											
molle				*			*						*									*			*		
terebinthifolius	16,3	3,0	3,0				9,4	3,0	2,2																3,7	3,0	1,1
Sesbania																											
punicea	25,0	3,0	**4,3**	1,7	2,0	0,5	**15,1**	3,0	3,4	2,3	1,0	1,5	11,1	1,0	4,1	*			9,8	1,0	1,6	6,6	1,0	1,8	10,0	3,0	2,6
Solanum																											
hermannii	1,3	4,0	0,3				0,7	4,0	0,2																0,3	4,0	0,1
mauritianum	56,3	4,0	**12,7**	20,3	3,0	**8,5**	41,0	4,0	**11,8**				20,8	3,0	**18,6**	22,2	6,0	**26,0**	92,2	5,0	**44,9**	34,1	5,0	**33,5**	36,9	5,0	**20,9**
pseudocapsicum																			*			*			*		
seaforthianum	*						*																		*		
Spathodea																											
campanulata	*						*																		*		
Spiraea																											
cantoniensis																			2,0	1,0	0,3	0,5	1,0	0,1	0,3	1,0	0,1

F = % frequency of occurrence; A = mean abundance rating; P = prominence value; * = species occurring in the given category but not included in a formal recording in a road transect; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

TABLE 7.—Alien species occurring in roadside and veld habitats (continued)

Veld type category and biome	Savanna Biome									Grassland Biome															Total study area		
	Tropical forest			Tropical bush & savanna			Total			Temperate grassland			Dry sub-tropical grassland			Moist sub-tropical grassland			Mistbelt grassland			Total					
No. road transects	80			59			139			43			72			45			51			211			350		
	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P
Syzygium cuminii	*			1,7	2,0	0,5	0,7	2,0	0,1																0,3	2,0	0,1
Thevetia peruviana	5,0	1,0	0,8	*			2,9	1,0	0,6																1,1	1,0	0,3
Tipuana tipu																			*			*			*		
Tithonia diversifolia	10,0	3,0	1,8	*			5,8	3,0	1,3										*			*			2,3	3,0	0,7
Ulex europaeus																2,2	2,0	0,7				0,5	2,0	0,1	0,3	2,0	0,1
Yucca sp. cf. *aloifolia*	2,5	2,0	0,4				1,4	2,0	0,3				1,4	2,0	0,6				2,0	1,0	0,3	0,9	1,0	0,3	1,1	1,0	0,3

F = % frequency of occurrence; A = mean abundance rating; P = prominence value; * = species occurring in the given category but not included in a formal recording in a road transect; bold numbers = the highest prominence values in a given category which add up to ± 80% of the summed prominence values (see text).

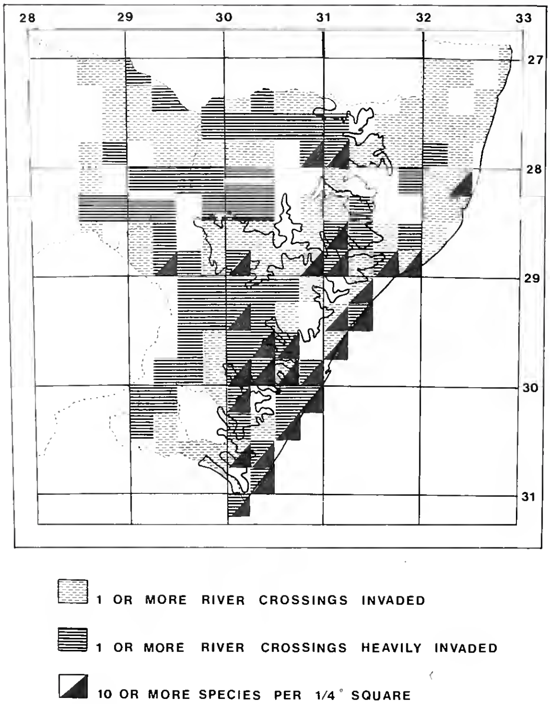

FIGURE 3.—Invasion in streambank habitats in terms of the intensity of invasion of watercourse crossings and species diversity per quarter degree square.

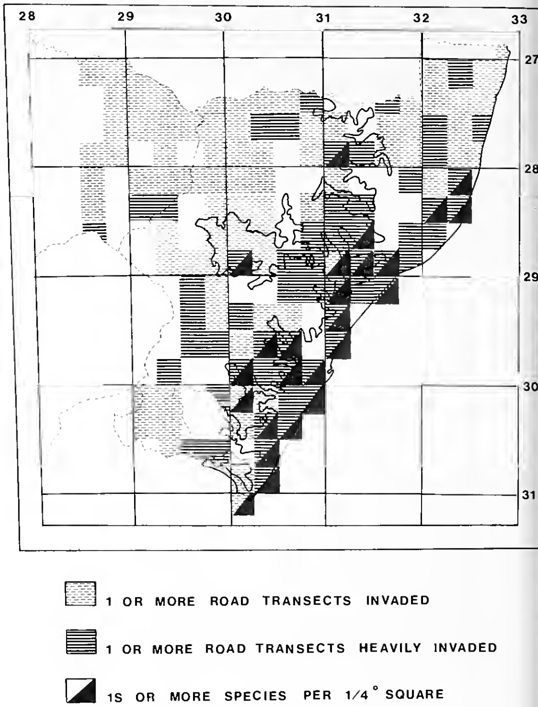

FIGURE 4.—Invasion in roadside and veld habitats in terms of the intensity of invasion of road transects and species diversity per quarter degree square.

with all situations and especially where only one species is present. The term 'commonest species' has not been defined but has been subjectively evaluated in terms of cover and density.

Prominent and potentially important species

Although 130 species were recorded in the study area, most invasion can be attributed to the following species: *Chromolaena odorata*, *Psidium guajava* and *Lantana camara* in the Savanna Biome and *Acacia dealbata*, *A. mearnsii*, *Solanum mauritianum* and *Rubus* spp. in the Grassland Biome.

Chromolaena odorata is the most outstanding invader in Natal. Its vigorous growth, prolific seed production (1 300 000 seeds annually per plant have been recorded) and efficient dispersal mechanism have enabled it to rapidly encroach large areas (Erasmus 1986). It is thought to have been unintentionally introduced to Durban during the Second World War (1939–1945). By 1950 it was conspicuous as a weed and had spread 120 km north of Durban (Liggitt 1983). By 1962 it was spreading 'virulently' along the Natal coast (Erasmus 1986). By 1981 it was recorded from Kosi Bay just south of the Mozambique border and by the mid 1980's it was recorded as far south as Hluleka Nature Reserve on the Transkei coast (about 300 km south of Durban) and in the Wolkberg in the north-eastern Transvaal (about 650 km north of Durban) (Macdonald 1984).

In the study area *C. odorata* is virtually confined to the narrow, hot and moist coastal belt of Natal (Figure 6J) where it forms dense monospecific thickets. It accounts for 23% of the total invasion recorded in roadside and veld habitats in the whole study area. From Mtunzini southwards it is exceedingly abundant, especially along

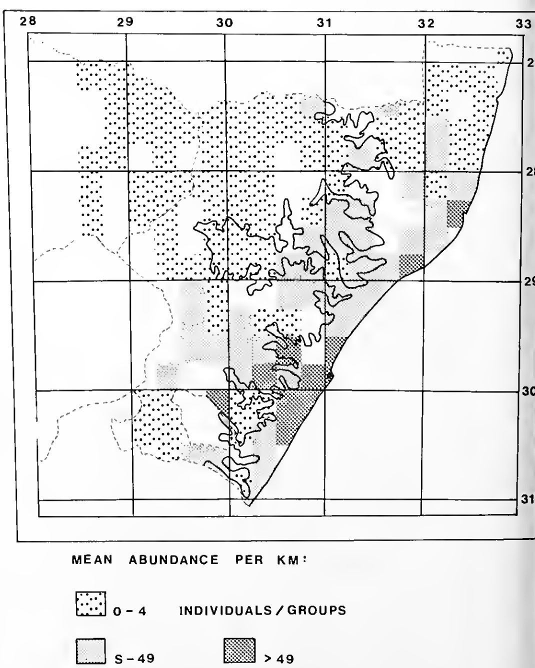

FIGURE 5.—Invasion in roadside and veld habitats in terms of the mean abundance of invaders per kilometre in each quarter degree square.

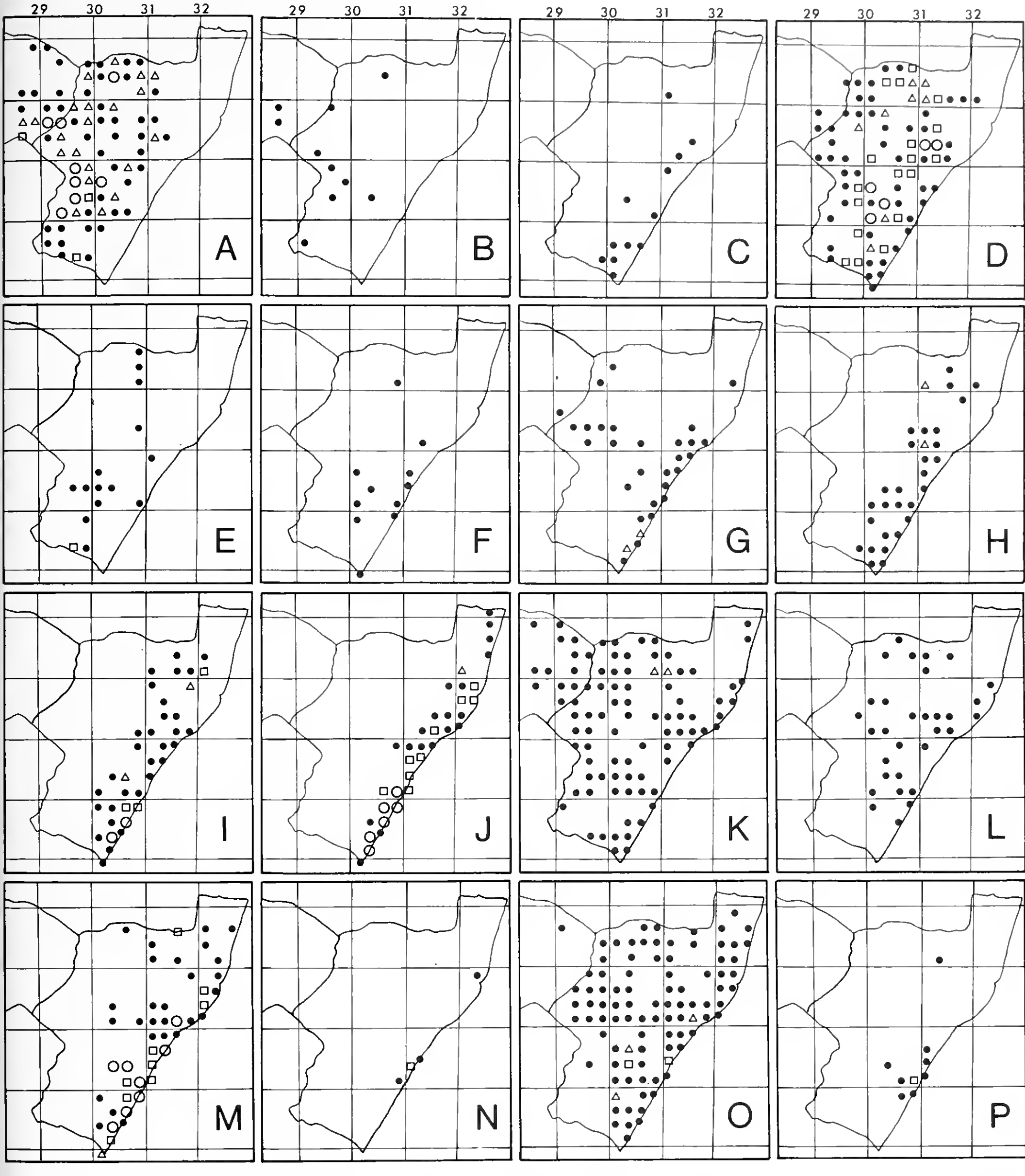

FIGURE 6.—Distribution and high abundance areas of the most prominent species: A, *Acacia dealbata*; B, *A. decurrens*; C, *A. longifolia*; D, *A. mearnsii*; E, *A. melanoxylon*; F, *A. podalyriifolia*; G, *Arundo donax*; H, *Caesalpinia decapetala*; I, *Cassia didymobotrya*; J, *Chromolaena odorata*; K, *Eucalyptus* spp.; L, *Jacaranda mimosifolia*; M, *Lantana camara*; N, *Leucaena leucocephala*; O, *Melia azedarach*; P, *Montanoa hibiscifolia*. Roadside and veld habitats, □, highest abundance rating of 5 or more; streambank habitat, Δ, highest abundance rating of 5 or more; streambank, roadside and veld habitats, ○, with the aforementioned values.

roadsides where it forms continuous stands. It frequently forms a dense margin to bush clumps and forest patches. North of Mtunzini it is locally abundant on the western shores of Lake St Lucia. Further north it is relatively scarce but has been observed at Manzengwenya and at Manguzi about 15 km south of the Mozambique border (M.C. Ward pers. comm.). It is absent from dry bush and savanna except where it has made incursions along watercourses.

C. odorata is native to a large area which includes Central and South America and the Caribbean Islands. According to preliminary findings the Natal plants are morphologically most similar to plants growing at Manaus (Amazonian region) in northern Brazil (R.L. Kluge pers. comm.). Based on these findings and the rampant growth of *C. odorata* in the tropical coastal belt of Natal it is predicted that it has the potential to invade the tropical East African coast up to Somalia. It is already present in equatorial West Africa in the Ivory Coast (Erasmus 1986), Cameroon (National Herbarium, Pretoria), Ghana and Nigeria (Holm *et al.* 1979). Its southern limit as a major weed is likely to be defined by Acocks's Veld Type, Coastal Forest and Thornveld (to which it is almost confined in

Natal) near East London in the eastern Cape of South Africa. Further south to Port Elizabeth the coastal forests become progressively more arid and unsuitable for growth of *C. odorata*. Beyond Port Elizabeth the coastal Knysna Forest, although receiving a high rainfall and no frost, is probably too temperate for the likes of this tropical weed. In Natal this species has virtually reached the limits of its distribution but it is expected to increase in density throughout its range especially in the northern coastal belt unless strict control measures are exerted.

Psidium guajava was the most frequently recorded invader of roadside and veld habitats in the coastal belt and the second most abundant after *Chromolaena odorata*. It not only invades roadsides and other highly disturbed sites, where it can form dense stands, but also coastal grasslands, bush clumps, forest patches and riverine vegetation. It is the author's contention that the importance of this species in Natal was greatly underestimated at the 1984 workshop meeting (Macdonald & Jarman 1985). This survey has shown that it is one of the most prominent invaders in the very land use types—utility areas and

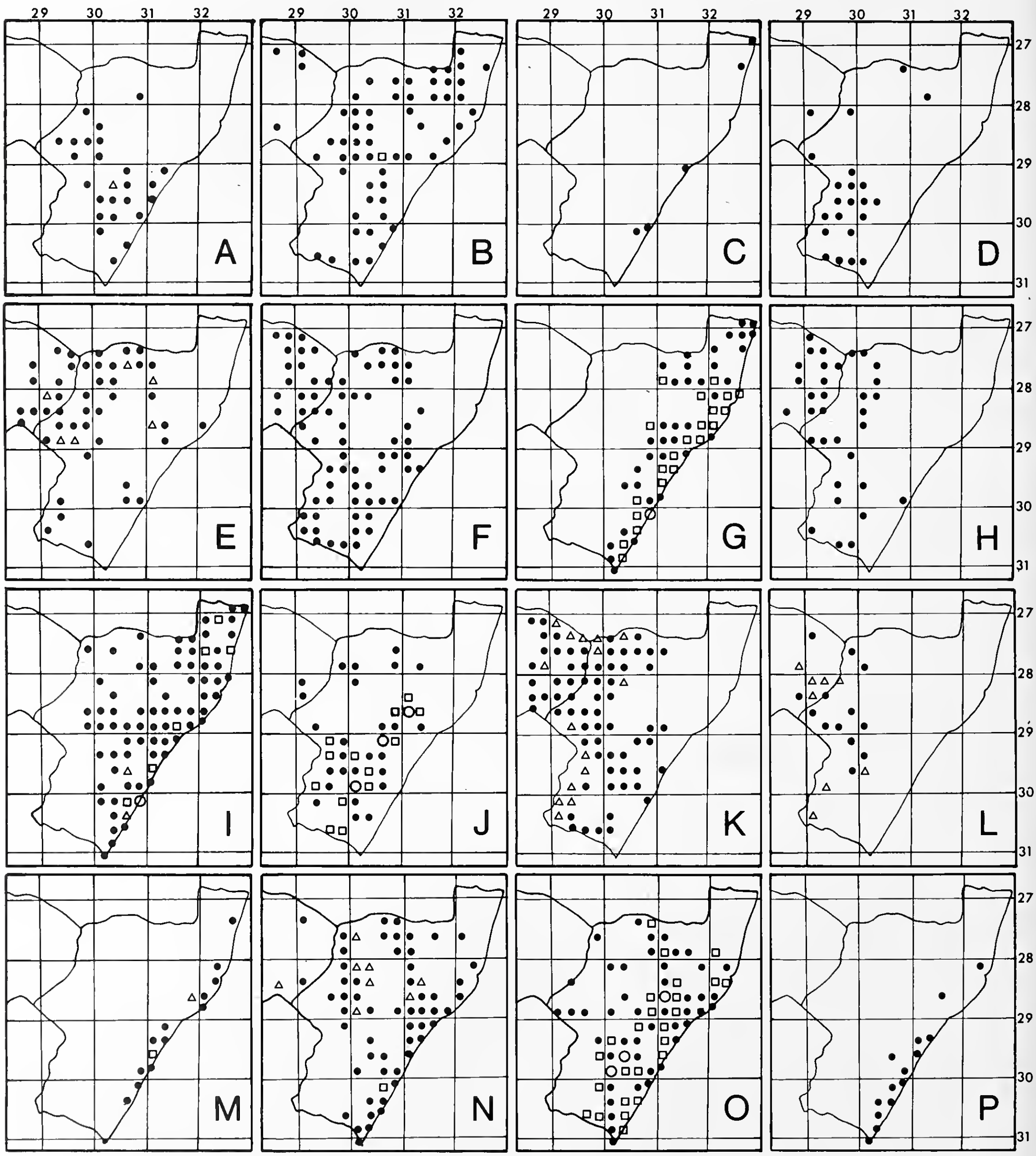

FIGURE 7.—Distribution and high abundance areas of the most prominent species: A, *Morus alba*; B, *Opuntia ficus-indica*; C, *Pereskia aculeata*; D, *Pinus patula*; E, *Populus × canescens*; F, *Prunus persica*; G, *Psidium guajava*; H, *Pyracantha* spp.; I, *Ricinus communis*; J. *Rubus* spp.; K, *Salix babylonica*; L, *S. lasiandra*; M, *Schinus terebinthifolius*; N, *Sesbania punicea*; O, *Solanum mauritianum*; P, *Tithonia diversifolia*. Roadside and veld habitats, □, highest abundance rating of 5 or more; streambank habitat, ▲, highest abundance rating of 5 or more; streambank, roadside and veld habitats, ○, with the aforementioned values.

coastal urban open space—where it was considered unimportant and which significantly lowered its importance ranking. As could have been expected, the survey showed that *Psidium guajava* was not abundant in the Durban metropolitan area on which the workshop based their coastal urban open space judgements. It is not known why this area differs in this respect from the other urban areas in the coastal zone.

Lantana camara has a wider climatic tolerance than the previous two species but grows best in the hot and humid coastal belt where it can form dense thickets. It is abundant along the coast south of Lake St Lucia but scarce north of this point (Figure 6M). It is abundant along the Pongola, Usutu and Ingwavuma Gorges in the aftermath of the floods caused by cyclone Demoina in January 1984 (M.C. Ward pers. comm.).

Solanum mauritianum is a widespread invader in the mistbelt and coastal belt of Natal (Figure 7O). It is most abundant in mistbelt grassland where it forms dense stands along roadsides and is a major understorey weed of plantations (Le Roux 1982).

Acacia mearnsii is widely naturalized in Natal but is most abundant in the midlands where it has been commercially planted on a vast scale (Figure 6D). It is least abundant in the high grasslands, coastal belt and tropical bush and savanna. In the whole study area it rated as the second most prominent riverine invader after *A. dealbata*.

Acacia dealbata is a widespread invader in the study area. Its distribution stretches from the temperate grasslands of the Orange Free State down to the Natal Mistbelt and even into the rivers of tropical bush and savanna (Figure 6A). It is by far the most serious invader of watercourses in the Grassland Biome. Its massive seed production and efficient downstream dispersal have enabled it to penetrate watercourses far from plantings. It rated equally prominent as *A. mearnsii* in mistbelt grassland although it has been planted there to a much lesser degree.

Rubus spp., mainly *R. cuneifolius*, are most abundant in the Natal mistbelt and foothills of the Drakensberg in southern Natal (Figure 7J). They are major understorey weeds in Pine plantations (Le Roux 1982) and form dense stands in open grassland and along road verges.

The aforementioned seven most prominent species in the study area are not likely to greatly increase their distribution ranges. *Solanum mauritianum* can be expected to invade the coastal plains north of Lake St Lucia. *Chromolaena odorata, Psidium guajava* and *Lantana camara* are all expected to expand their distributions in the same region. Further expansion by all seven species will probably occur in marginally suitable areas. All species can be expected to increase in density within their ranges.

Melia azedarach and *Ricinus communis* are widespread but most common in the coastal belt (Figures 6O & 7I). They are considerably less abundant than the species already mentioned and therefore received lower prominence rankings.

Ricinus communis has always been regarded as an introduced weed from elsewhere in Africa. However, recent archaeological diggings in the eastern Cape have unearthed seeds of this species from a grass-lined storage pit dating back more than 1 200 years (Brink 1988). This suggests that, if indeed introduced, primitive hunter-gatherers were the agents (Brink 1988). This is in sharp contrast to the majority of our foreign weeds which have been introduced since the colonization of the Cape 300 years ago. Whether it is classified as an alien or indigenous plant, *R. communis* is not generally regarded as an important weed (e.g. Macdonald 1983) because it is a pioneer plant, colonizing disturbed sites, and eventually giving way to longer-lived species.

Melia azedarach on the other hand is a long-lived tree and can grow to a considerable size (12–23 m in height and a spreading canopy) (Poynton 1972). Add to this its production of vast quantities of berries which are dispersed by birds and water, its high germinability, its hardiness to drought and cold, rapid growth and its response to felling by coppicing profusely, then it deserves recognition as an important invader. It is most important in streambank habitats where its efficient downstream dispersal enables it to invade protected areas far from source areas (Macdonald 1983). In this survey it rated as the most prominent tree species in tropical bush and savanna. It has virtually reached the limits of its distribution in the study area but can be expected to increase in abundance especially along river banks in the Savanna Biome.

Salix babylonica is a widespread streambank invader in the upland grasslands (Figure 7K). It is unable to reproduce sexually as only female trees have been introduced into South Africa, but reproduces vegetatively from branches which are torn from trees by floodwaters and deposited downstream (Poynton 1973). It does not form dense stands like the *Acacia* spp. but a single large tree probably achieves the same basal area as 10, 20 or more *Acacia* trees. It can also effectively exclude the growth of other species under its canopy (pers. obs.). In places such as along the Umzimvubu River in south-western Natal, it forms continuous stands which stretch for many kilometres.

Salix lasiandra, referred to by Immelman (1987), is less widely distributed (Figure 7L) than *S. babylonica* but it too can form continuous stands in places. It is particularly abundant along the Wilge River near Harrismith. It is more widely distributed and abundant in southern Natal than shown in Figure 7L but the data are not available as it was mistaken for an indigenous *Salix* species during this part of the survey.

Sesbania punicea was the fourth most prominent streambank invader in the study area. It was locally abundant along watercourses in the interior and along roadsides in the humid coastal belt (Figure 7N). Three species of herbivorous weevils have been imported for biological control of this weed. Already one of the weevils has made an outstanding contribution to the biological control of *S. punicea* and, in combination with the two other species, is expected to halt the invasive spread of this plant in South Africa (Hoffmann & Moran 1988).

Opuntia spp. are widely distributed in the study area but occur mainly as scattered plants. *Opuntia ficus-indica* (Figure 7B) and *O. stricta* are locally abundant in the Tugela River valley and elsewhere in tropical bush and savanna. *Opuntia vulgaris* occurs as widely scattered plants in the coastal belt. All these species have been the subjects of biological control campaigns and their numbers have been greatly reduced. They are no longer considered a threat but may still form localized infestations (Zimmermann *et al.* 1986).

Cassia didymobotrya (Figure 6I) and *Caesalpinia decapetala* (Figure 6H) are fairly widespread in the coastal belt and mistbelt of Natal. They are locally abundant, particularly in disturbed sites around kraals, villages, along roadsides and riverbanks. *Cassia didymobotrya* is a central African plant and although very abundant in places it is mainly a pioneer plant. Flowering specimens are invariably host to a caterpillar which may help to control the spread of this species. *Caesalpinia decapetala* is a vigorous-growing, exceedingly thorny woody shrub or climber that can form a dense canopy that smothers the existing vegetation and excludes other species. It is particularly troublesome as an invader of forest margins. It is easily overlooked during a roadside survey when not flowering and thus is likely to be more widely distributed and abundant than shown.

Less widespread species which are locally abundant and can form dense stands include: *Arundo donax* (Figure 6G), *Pereskia aculeata* (Figure 7C), *Pinus elliottii* (Macdonald & Jarman 1985), *Schinus terebinthifolius* (Figure 7M) and *Solanum seaforthianum* in the coastal belt; *Tithonia diversifolia* (Figure 7P), *Montanoa hibiscifolia* (Figure 6P) and *Leucaena leucocephala* (Figure 6N) around Durban; *Cardiospermum grandiflorum* and *Cestrum laevigatum* in the Pietermaritzburg, Durban and coastal areas and *Populus* × *canescens* (Figure 7E) along streambanks in the Grassland Biome. *Ulex europaeus* and *Cytisus scoparius* have been known to form dense stands in moist subtropical grassland at the Highmoor Forest Estate (National Herbarium specimens collected by D. Edwards in 1961).

Arundo donax, the giant reed, has invaded streambank habitats largely unnoticed because it is similar in appearance to the indigenous reeds (*Phragmites* spp.). In the Natal coastal belt, where it forms dense stands in places and flowers prolifically, it can be easily recognised by its large inflorescence with dense ascending branches. Suitable habitat for this species occurs along river banks throughout the Savanna Biome. It can be expected to expand its distribution in this region.

Schinus terebinthifolius is a popular ornamental and hedge plant in the coastal belt and produces large numbers of berries. There have been observations of seed predation by insects which has probably prevented it from becoming a serious weed (S. Neser pers. comm.). It should nevertheless be regarded as a potentially important invader since it has become a pest in other parts of the world, can thrive at the outer limits of vegetation exposed to salt spray and has even invaded mangroves in Florida, USA (Morton 1978; Toufexis 1985). Dense stands of this species were observed in the Umgeni River in Durban North just upstream of the Beachwood Mangroves Nature Reserve.

If seed is made available *S. terebinthifolius* may even threaten the swamp forests of Maputaland in north-eastern Natal. This habitat is of very limited extent and according to Macdonald & Jarman (1985) is the least invaded of any habitat in Natal. However several species are being cultivated in these swamps, namely *Mangifera indica, Carica papaya, Musa* sp. and *Ananas* sp. *M. indica* is naturalized in the swamp forest at Kosi Bay.

Concern has been expressed about the invasiveness of *Litsea glutinosa* in the coastal lowlands of Natal (Macdonald & Jarman 1985). According to records in the National Herbarium it has been much planted in Durban, regenerates easily from seed and it was recorded as naturalized in the Eshowe District as far back as 1937. It is regarded as a weed on the island of Mauritius (Holm *et al.* 1979).

Pereskia aculeata is potentially a very serious invader of coastal forests. It is a very thorny vigorous-growing climbing cactus which can smother and kill the trees it overtops. Its current widespread distribution in the conservation areas of the coastal lowlands in northern Natal is mainly thought to be the result of previous intentional plantings around kraals and burial sites (Macdonald & Jarman 1985). Natural spread from these sites of previous introduction has in many localities been surprisingly limited given its bird-dispersed fruit. But the rate at which it can be spread by frugivorous animals and by vegetative reproduction, is potentially rapid (Macdonald & Jarman 1985). Campbell (1988) reports that the seed is geared for rapid germination in a range of habitats but that the soil seed bank is likely to deteriorate rapidly, with the occurrence of either germination or seed death.

P. aculeata is a difficult weed to control as any part of the plant which survives treatment can reproduce vegetatively and restart the thicket. Control methods involving slashing, poisoning and burning can result in the total destruction of all vegetation in the affected area (Bruton 1981). However, in several KwaZulu nature reserves infestations have been hand-cleared with as little disturbance as possible. Hand-weeding and herbicide treatments are necessary in follow-up operations (Macdonald & Jarman 1985).

Relation of invasion to environmental factors

Alien invasion is related to indigenous veld type categories and broad climatic factors. There is a general trend for more invasion in terms of species diversity and abundance with decreasing elevation from the cold upland grasslands to the warm coastal belt. Most invasion occurs in the humid to subhumid coast (tropical forest) and mistbelt (mistbelt grassland) where there is little or no incidence of frost. There is considerably less invasion, particularly in roadside and veld habitats, in the colder and drier veld types.

The limited invasion of the northern coastal belt relative to that in the south of the province is interpreted as being a result of less disturbance and fewer plantings of alien species. Localized infestations, for example around Lake St Lucia, indicate that this region is vulnerable to invasion. According to Liggitt (1983) *Chromolaena odorata* is spreading rapidly in the north where up to 2000%

increases in vegetation cover have been recorded in the Dukuduku plantations during a time span of five years.

The distributions of some species correspond well with broad climatic zones. For example *Chromolaena odorata* is virtually restricted to the frost-free and moist coastal belt, although, being wind-dispersed, it has a potentially wide distribution. Members of the Rosaceae, such as *Rubus, Rosa, Prunus, Pyracantha* and *Cotoneaster* spp., are most evident in the cold high-lying grasslands. This may be attributable to a dormancy mechanism in their seeds which is terminated by cold winter temperatures (Dean *et al.* 1986).

Watercourses have played an important role in the dispersal of species and in particular those which otherwise have a limited dispersal range. For example *Acacia dealbata, A. mearnsii, Sesbania punicea* and *Caesalpinia decapetala* have rather immobile and hard seeds but which are readily transported by water. The abrasion which the seeds receive along their journey may well promote germination.

Watercourses have also enabled the long-range vegetative dispersal of species such as *Salix babylonica* and *Opuntia* spp. The spread of suckering species such as *Populus* × *canescens* and *Robinia pseudoacacia* is also promoted by stream flow.

Some of the important invader species are dispersed by birds enabling them to invade relatively undisturbed sites and far afield from parent plants. Notable species include *Lantana camara, Solanum mauritianum, Melia azedarach, Pyracantha* spp., *Psidium guajava, Rosa* spp. and *Rubus* spp. In the grassland regions bird-dispersed species are clearly associated with perching sites, such as fence lines, rocky outcrops, bush clumps and plantations. In the mistbelt *Solanum mauritianum* and *Rubus cuneifolius* form dense thickets in the understoreys of plantations.

CONCLUSION

The intensity of alien plant invasion is expected to increase in all parts of the study area and particularly in the coastal and mistbelts of Natal. Top priority should be given to the control of invaders, especially *Chromolaena odorata*, in north-eastern Natal [see Macdonald & Jarman (1985), where a possible control strategy is detailed] which is an important conservation area and where the potential for expansion is great.

Shortly after completion of this survey, in September/October 1987, Natal experienced devastating widespread floods. Most of the major river valleys as well as the floodplains along the coast were severely affected. Vast tracts of riverine vegetation that used to grow within the flood line were swept away. The long-term consequences of the floods remain to be seen but in the short-term it can be expected that an explosion of pioneer and other fast-growing plants will occur.

In the coastal belt *Chromolaena odorata* can be expected to rapidly invade floodplains, river banks and any other exposed land. *Ricinus communis* is likely to greatly increase in abundance especially in riverbeds as it did in the Pongola River after the floods caused by cyclone Demoina in January 1984. The floods are also expected to promote the downstream spread of water-dispersed species such as *Acacia dealbata, A. mearnsii, Melia azedarach* and *Salix babylonica*. The floods, together with the prospect of a wetter climatic cycle ahead (Tyson 1986), could result in the spread of species into areas which previously were too dry and inhospitable. In this respect there is a danger that *A. dealbata* and *C. odorata* will become more widely established and abundant in bush and savanna.

An assessment of the ecological consequences of streambank invasion, particularly pertaining to water usage and soil conservation, is considered to be extremely important in the motivation for the control of streambank invaders. *Acacia dealbata* and *A. mearnsii*, although declared invaders, have spread uncontrolled throughout the Grassland Biome from the upland grasslands along the Drakensberg escarpment down into the mistbelt. In the case of *A. mearnsii* it has even spread into the coastal belt.

Apart from a few notable exceptions most of the important alien woody invader species in Natal and the rest of South Africa (Henderson & Musil 1984; Macdonald & Jarman 1984; Macdonald *et al.* 1986; Stirton 1978) have been cultivated either on a grand scale in plantations, or as barrier plantings, cover/binders, shelterbelts and ornamentals in gardens. This raises the issue of screening alien plant species for potential invasiveness before they are allowed to be propagated on a grand scale. This applies particularly to the establishment of plantations of species new to the region belonging to the genera *Acacia* and *Pinus*, many species of which have become serious invaders in South Africa.

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APPENDIX

The names of 180 species of naturalized alien trees, shrubs and climbers are listed. Some non-woody species are included. Names and dates in brackets: literature references. (PRE): cited on National Herbarium specimen labels.

Acacia
dealbata Link, silver wattle
decurrens Willd., green wattle
farnesiana (L.) Willd. (Ross 1972), sweet acacia
longifolia (Andr.) Willd., long-leaved wattle
mearnsii De Wild., black wattle
melanoxylon R. Br., blackwood
podalyriifolia A. Cunn. ex G. Don, pearl acacia
saligna (Labill.) Wendl. (MacDonald & Jarman 1985), Port Jackson willow
Agave
americana L., century plant
sisalana Perrine, sisal
Ageratina adenophora (Spreng.) R.M. King & H. Robinson, crofton weed
Ailanthus altissima (Mill.) Swingle, tree-of-heaven
Albizia
lebbeck (L.) Benth. (Ross 1972), lebbeck tree
procera (Roxb.) Benth. (Ross 1972), false lebbeck
Anacardium occidentale L. (Ross 1972), cashew
Anredera
baselloides (H.B.K.) Baill. (Ross 1972)
cordifolia (Ten.) Steenis (PRE), Madeira vine
Antigonon leptopus Hook. & Arn., Mexican creeper
Araujia sericifera Brot. (PRE), moth catcher
Arundo donax L., giant reed
Bambusa balcooa Roxb. ex Roxb., common bamboo
Bambuseae spp., (two small spp., one possibly *Phyllostachys* sp.), bamboos
Basella paniculata Volkens (Ross 1972)
Bauhinia variegata L., white orchid tree
Caesalpinia decapetala (Roth) Alston, Mauritius thorn
Cajanus cajan (L.) Millsp. (Ross 1972), Congo pea
Canna
edulis L. (MacDonald & Jarman 1985), edible canna
indica L., canna
Cardiospermum grandiflorum Schwartz, balloon vine
Carica papaya L., papaya
Cassia
bicapsularis L.
coluteoides Collad.
corymbosa Lam. (PRE), autumn cassia
didymobotrya Fresen., peanut-butter cassia
floribunda Cav., arsenic bush
hirsuta L.
occidentalis L., wild coffee
Casuarina
equisetifolia G. Forst., horsetail tree
sp. cf. *C. cunninghamiana* Miq., beefwood
Cedrela odorata L. (PRE), West Indian Cedar
Cedrus deodara (Roxb.) G. Don, deodar
Ceiba pentandra (L.) Gaertn. (Ross 1972), kapok tree
Cereus peruvianus (L.) Mill., queen of the night
Cestrum
aurantiacum Lindl., yellow cestrum
laevigatum Schlechtd., inkberry
Chromolaena odorata (L.) R.M. King & H. Robinson, triffid weed
Cinnamomum camphora (L.) J. Presl, camphor tree
Citrus
aurantium L. (MacDonald & Jarman 1985), sour orange
limon (L.) Burm. f. (MacDonald & Jarman 1985), lemon
reticulata Blanco (MacDonald & Jarman 1985), mandarin
Colocasia esculenta (L.) Schott, taro
Cortaderia sp., pampas grass
Cotoneaster franchetii Bois, orange cotoneaster

Cotoneaster sp., cotoneaster
Crataegus phaenopyrum (L. f.) Medic., Washington thorn
Crotalaria agatiflora Schweinf. subsp. *imperialis* (Taub.) Polhill, canary-bird bush
Cryptomeria japonica (L. f.) D. Don, Japanese cedar
Cupressus sp. cf. *C. arizonica* Greene, Arizona cypress
Cupressus spp., cypresses
Cyphomandra betacea (Cav.) Sendtn. (PRE), tree tomato
Cytisus scoparius L., Scotch broom
Dahlia imperialis Roezl. ex Ortg., tree dahlia
Delonix regia (Bojer) Raf., flamboyant
Duranta erecta L. (= *D. repens* L.) (Ross 1972), forget-me-not-tree
Eriobotrya japonica (Thunb.) Lindl. (MacDonald & Jarman 1985), loquat
Eucalyptus
elata Dehnh. (= *E. andreana* Naud.) (Ward 1980), river peppermint
camaldulensis Dehnh., red gum
cinerea F.J. Muell. ex Benth., florist's gum
grandis W. Hill ex Maid. (MacDonald & Jarman 1985), saligna gum
robusta Sm., swamp mahogany gum
Eucalyptus spp., gums
Euphorbia pulcherrima Willd. ex Klotzsch, poinsettia
Gleditsia triacanthos L., honey locust
Gmelina arborea Roxb. (Dyer 1975), white teak
Grevillea robusta A. Cunn., Australian silky oak
Hakea sericea Schrad. (= *H. tenuifolia* (Salisb.) Domin) (Moll 1981), silky hakea
Harrisia martinii (Labouret) Britton (Henderson *et al.* 1987), moon cactus
Hedychium
coronarium J. König, butterfly ginger
flavum Roxb.
Hylocereus undatus (Haw.) Britt. & Rose (PRE), night-blooming cereus
Ipomoea
alba L., moon flower
coccinea L. (Ross 1972), red morning-glory
congesta R. Br.
fistulosa Choisy
nil (L.) Roth (Ross 1972)
purpurea (L.) Roth (Ross 1972), common morning-glory
Jacaranda mimosifolia D. Don, jacaranda
Jatropha curcas L. (PRE), physic nut
Lagerstroemia indica L., pride-of-India
Lantana camara L., lantana
Lespedeza cuneata (Du Mont) G. Don (Ross 1972), bush clover
Leucaena leucocephala (Lam.) De Wit, leucaena
Ligustrum ovalifolium Hassk. (PRE), California privet
Litsea glutinosa (Lour.) C.B. Robinson (= *L. sebifera* Pers.) (MacDonald & Jarman 1985), Indian laurel
Macfadyena unguis-cati (L.) A. Gentry (PRE), cat's-claw creeper
Mangifera indica L., mango
Manihot sp., cassava
Melia azedarach L., syringa
Metasequoia glyptostroboides H.H. Hu & Cheng, dawn redwood
Monstera deliciosa Liebm., Swiss-cheese plant
Montanoa
bipinnatifida (Kunth) C. Koch (Moll 1981), tree daisy
hibiscifolia Benth.
Morus
alba L., white mulberry
alba L. var. *multicaulis*
Musa sp., banana
Nerium oleander L., oleander
Nicotiana glauca R.C. Grah., wild tobacco
Opuntia
dillenii (Ker-Gawl.) Haw. (Henderson *et al.* 1987), pipestem prickly pear
exaltata A. Berger (Henderson *et al.* 1987), long-spine cactus
ficus-indica (L.) Mill., sweet prickly pear
imbricata (Haw.) DC. (Henderson *et al.* 1987), chain-link cactus
spinulifera Salm-Dyck, large round-leaved prickly pear
stricta Haw., pest pear of Australia
vulgaris Mill., cochineal prickly pear
Pandanus spp., screw-pines
Paraserianthes lophantha (Willd.) Nielsen subsp. *lophantha* (= *Albizia lophantha* (Willd.) Benth.) (Ross 1972), stinkbean
Parkinsonia aculeata L. (Ross 1972), Jerusalem thorn
Passiflora
edulis Sims, purple granadilla
foetida L., love-in-a-mist
suberosa L. (Ross 1972)
subpeltata Ortega (Ross 1972), granadina
Pennisetum purpureum Schumach., elephant grass
Pereskia aculeata Mill., Barbados gooseberry
Persea americana Mill. (PRE), avocado pear
Pinus
canariensis Sweet ex K. Spreng., Canary pine
elliottii Engelm. (MacDonald & Jarman 1985), slash pine
patula Schlechtd. & Cham., patula pine
? *taeda* L., loblolly pine
sp. cf. *P. uncinata* Mill. ex Mirb.
Pinus spp., pines
Populus
× *canescens* (Ait.) J.E. Sm., grey poplar
deltoides Bartr. ex Marsh., match poplar
nigra L. var. *italica* Muenchh., Lombardy poplar
Prunus
armeniaca L., common apricot
persica (L.) Batsch., peach
Psidium
guajava L., common guava
littorale Raddi var. *longipes* (O. Berg) Fosb. (= *P. cattleianum* Sabine) (Ross 1972), strawberry guava
Punica granatum L., pomegranate
Pyracantha
angustifolia (Franch.) C.K. Schneid., yellow firethorn
fortuneana (Maxim.) H.L. Li
rogersiana (A.B. Jacks.) Bean
sp. cf. *P. coccinea* M.J. Roem., red firethorn
Quercus robur L., English oak
Robinia pseudoacacia L., black locust
Rosa
eglanteria L., eglantine
odorata (Andr.) Sweet, tea rose
sp. cf. *R. multiflora* Thunb. ex J. Murr. (PRE), baby rose
Rubus
affinis Wight & Arn., blackberry
cuneifolius Pursh., American bramble
phoenicolasius Maxim. (Spies & Du Plessis 1985), wineberry
Saccharum officinarum L., sugar cane
Salix
babylonica L., weeping willow
caprea L., pussy willow
lasiandra Benth.
Sambucus
canadensis L., American elder
nigra L. (PRE), European elder
Schinus
molle L., pepper tree
terebinthifolius Raddi var. *acutifolius* Engl., Brazilian pepper tree
Sesbania
bispinosa (Jacq.) W.F. Wight var. *bispinosa* (Ross 1972), spiny sesbania
punicea (Cav.) Benth., red sesbania
Solanum
hermannii Dun., bitter apple
mauritianum Scop., bug tree
pseudocapsicum L., Jerusalem cherry
seaforthianum Andr., potato creeper
Spathodea campanulata Beauv., African flame tree
Spiraea cantoniensis Lour., Reeves spiraea
Syncarpia glomulifera (Sm.) Niedenzu (MacDonald & Jarman 1985), turpentine tree
Syzygium cumini (L.) Skeels, Java plum
Thevetia peruviana (Pers.) K. Schum., yellow oleander
Tipuana tipu (Benth.) O. Kuntze, tipu tree
Tithonia
diversifolia (Hemsl.) A. Gray, Mexican sunflower
rotundifolia (Mill.) S.F. Blake (Ross 1972)
Toona ciliata M.J. Roem. (MacDonald & Jarman 1985), toon tree
Ulex europaeus L., gorse
Vitex trifolia L. (Ross 1972)
Yucca sp. cf. *Y. aloifolia* L., Spanish bayonet

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Miscellaneous notes

VARIOUS AUTHORS

IMPROVING THE RESOLUTION OF FLORISTIC/HABITAT PATTERN CORRELATIONS ON PHYTOSOCIOLOGICAL TABLES

INTRODUCTION

One of the aims of causal-analytical vegetation research is to analyse the reaction of plant groups to a combination of habitat factors. In particular, it is important to recognize the factors that are primarily responsible for floristic differentiation (Mueller-Dombois & Ellenberg 1974). Tabular portrayal of vegetation-habitat relationships is an effective means of realizing this objective. Traditionally, habitat factors in the form of itemized symbols are appended above the floristic classification without any attempt at clustering on the basis of similarity (Bredenkamp 1975; Robinson 1976; Van der Meulen 1979; McDonald 1983; Van Rooyen 1983; Westfall 1985). Presentation of habitat data in this format may be termed 'passive' since these data require no additional manipulation. Interpretation in this context, however, can be difficult and cumbersome. An improved method of portraying habitat correlations, whereby 'diagnostic' groups of habitat factors are juxtaposed above floristic units, is described here. This involves a more 'active' type of habitat classification.

METHODS

In the Braun-Blanquet phytosociological approach, as described by Westhoff & Van der Maarel (1973), Werger (1974) and Mueller-Dombois & Ellenberg (1974), the cover-abundance of plant species in stands of vegetation is presented in two-way tables with columns representing stands (relevés) and rows representing species. Columns are re-arranged so as to group relevés having similar species and rows are re-arranged to group species occupying similar relevés.

By treating habitat factors as species on a presence/absence basis, they can be re-arranged within the framework of a floristic classification to form diagnostic groups of habitat/environmental factors.

The PHYTOTAB computer package (Westfall *et al.* 1982) was used to structure a floristic table for the grasslands of the Sabie area, Eastern Transvaal Escarpment. Thirteen syntaxa (including nine communities) were elicited from 37 relevés. In a separate table, habitat and structural data rows pertaining to each relevé were superimposed on the floristic classification and re-arranged into groups occupying similar relevés. In this way, habitat groups were highlighted in the same fashion as species groups (Table 1).

RESULTS AND DISCUSSION

The habitat groups provide a ready means of identifying and 'labelling' the different syntaxa. For example, the *Gladiolus densiflorus–Loudetia simplex* Short Closed Grassland (Community 45) is found on the Escarpment Lower Slopes in the Transitional Mistbelt between 1 112 m and 1 233 m elevation on level terraces in Land Type Ab33b (Table 1). Conversely, the *Cliffortia repens–Loudetia simplex* Short Open Shrubland (Community 46) is found on the Escarpment Upper Slopes on fairly rocky sites of Land Type Ab36a (Table 1). These examples are taken from Deall (1985).

The habitat groups may also be useful for highlighting specific factors influencing floristic differentiation. For example, the *Wahlenbergia huttonii–Eragrostis racemosa* Low Closed Grassland (Community 49) is differentiated by the *Acrotome hispida* species group (Table 1: 10). Such differentiation is probably largely influenced by the red clay soils derived from Oaktree Dolomite (Table 1).

The advantages of 'active' as opposed to 'passive' classification of habitat for correlation with floristic classifications are manifold:

1, 'noise' is more easily observed;
2, pattern is better defined and therefore interpretability is enhanced;
3, pattern is not obscured by parameters with small class intervals;
4, gradients can, if necessary, be indicated by means of class intervals;
5, tables can, if necessary, be constructed independently of floristics;
6, there is practically no limit to the number of habitat-factor/class-interval combinations that can be used.

The portrayal of habitat factors in this manner is a convenient visual aid, facilitating rapid environmental interpretation of floristic classifications.

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TABLE 1.—Floristic classification and habitat correlation in Grassland of the Humid Mistbelt, Sabie Area (from Deall 1985)

Community number	45				46		47			48					49 A		49 B		
Relevé number	195	198	199	136	63	62	84	71	73	82	77	78	76	85	88	89	93	90	91
Habitat factors Total species per relevé	32	27	22	40	46	40	31	51	38	44	39	39	28	30	41	40	44	35	41
Transitional Mistbelt	+	+	+	+															
Escarpment Lower Slopes	+	+	+	+															
1 112–1 233 m elevation	+	+	+	+											+	+			
Land type Ab 33B	+	+	+																
Level slope (0–3,49 degrees)		+	+						+				+						
Land type Ab 36A				+	+	+		+											+
Short Open Shrubland					+	+													
5–34% rock cover					+	+		+	+										
Escarpment Upper Slopes					+	+		+											+
Nelspruit Granite	+	+	+		+	+		+											
Lowveld Sour Bushveld	+	+	+	+	+	+		+							+	+	+	+	+
1 356–1 478 m elevation									+	+	+	+	+	+					
Fairly deep soil (490–1 000 mm)							+			+			+	+					
Land type Ac 88A							+		+	+	+	+	+	+					
Upland Terrace							+		+	+	+	+	+						
Black B horizon		+					+				+								
Black A horizon		+			+	+		+			+	+	+	+					
Loamy sand A horizon						+							+						
Oaktree Dolomite															+	+	+	+	
Clay B horizon			+												+	+		+	
Red A horizon															+	+		+	+
(1) Differential species of the *Gladiolus densiflorus–Loudetia simplex* Short Closed Grassland (Community 45)																			
Indigofera sp. (Fb)	1	3	3	2															
Gladiolus densiflorus (Fb)	4	1	2														2	2	
Lopholaena disticha (Fb)	1	2	2																1
Aster comptonii (Fb)	2	2																	
Selago atherstonei (Fb)			2	2															
(2) Differential species of the *Cliffortia repens–Loudetia simplex* Short Open Shrubland (Community 46)																			
Lobelia decipiens (Fb)					3	3								3					
Cliffortia repens (Sh)					3	3													
Styppeiochloa gynoglossa (Gr)					3	3													
Senecio oxyriifolius (Fb)					3	2													
Helichrysum mimetes (Fb)					3	3													
Pycreus muricatus (Cy)					3	3													
(3) Differential species of the *Tetraselago natalensis–Monocymbium ceresiiforme* Low Closed Grassland (Community 47)																			
Microchloa caffra (Gr)								2	2	2									
Tephrosia elongata (Fb)								1	3										
(4) Differential species of Communities 46–47																			
Tetraselago natalensis (Fb)					4		2	3	2										
Mohria caffrorum (Pt)				2	2	2		2											
Eriospermum burchellii (Fb)						3	2		3										
Rhynchelytrum 'complex' (Gr)						2		3											
Pellaea viridis (Pt)					2			2											
(5) Differential species of Communities 45–47																			
Diospyros lycioides (Tr)	2		2		2			1									2		
Trichopteryx dregeana (Gr)			2		2			2											
Helichrysum panduratum (Fb)				2				2				1							

+ Denotes presence. Digits 1–9 in matrix denote Domin-Krajina cover-abundance values. Growth forms: Tr = tree; Sh = shrub; Ln = lianoid; Fb = forb or herb; Cy = sedge; Gr = grass; Pt = fern.

TABLE 1.—Floristic classification and habitat correlation in Grassland of the Humid Mistbelt, Sabie Area (from Deall 1985) (continued)

Habitat factors	45				46		47			48					49 A		49 B		
Relevé number	195	198	199	136	63	62	84	71	73	82	77	78	76	85	88	89	93	90	91
Total species per relevé	32	27	22	40	46	40	31	51	38	44	39	39	28	30	41	40	44	35	41

(6) Differential species of the *Rendlia altera–Monocymbium ceresiiforme* Low Closed Grassland (Community 48)

Species	195	198	199	136	63	62	84	71	73	82	77	78	76	85	88	89	93	90	91
Alloteropsis semialata subsp. *eckloniana* (Gr)					2					3	3	2	2						
Commelina sp. (Fb)										2	3	2	2						
Senecio erubescens (Fb)										1	3	2							
Senecio gerrardii (Fb)										2	2	1							
Nidorella auriculata (Sh)										2		1							
Athanasia calva (Fb)										2		2							
Helichrysum sp. (Fb)											3	4							
Drosera sp. (Fb)											3		2						
Helichrysum cephaloideum (Fb)											2		3	3					
Euphorbia striata (Fb)													3	1					
Polygala hottentotta (Fb)							2					1		2					

(7) Differential species of Communities 47–48

Species	195	198	199	136	63	62	84	71	73	82	77	78	76	85	88	89	93	90	91
Kyllinga alba (Cy)							2	3	2	3	3	3	2				2		
Rendlia altera (Gr)									5	3	6	9	2						
Tolpis capensis (Fb)								2	1		3	2		1					

(8) Differential species of Communities 46–48

Species	195	198	199	136	63	62	84	71	73	82	77	78	76	85	88	89	93	90	91
Selago muddii (Fb)						2			2	2	4		2	3					
Harpochloa falx (Gr)						2	2		1	1		2	6						
Koeleria capensis (Gr)						2		4		4	7		8						
Trachyandra saltii (Fb)						2		3		1			2	2					
Hypoxis filiformis (Fb)						2			2		3	3	4						
Stiburus alopecuroides (Gr)					2		6				1		2	2					
Panicum ecklonii (Gr)						2	4	2		3				3					
Stachys nigricans (Fb)						3	2					2							

(9) Differential species of Communities 45–48

Species	195	198	199	136	63	62	84	71	73	82	77	78	76	85	88	89	93	90	91
Hemizygia subvelutina (Fb)	2	3		3	4	3	3			2	2	3							
Athanasia acerosa (Fb)	1	3	3	1			2	1		5	5	4							

(10) Differential species of the *Wahlenbergia huttonii–Eragrostis racemosa* Low Closed Grassland (Community 49)

Species	195	198	199	136	63	62	84	71	73	82	77	78	76	85	88	89	93	90	91
Acrotome hispida (Fb)															3	2	3	2	
Hyparrhenia hirta (Gr)															4	3	4	3	
Wahlenbergia huttonii (Fb)															3	3	2	2	
Sporobolus 'complex' (Gr)								3							4	3	2	4	
Brachiaria subulifolia (Gr)															2	3	3		
Digitaria apiculata (Gr)															3		2	2	
Eriosema cordatum (Fb)															2		2	2	
Hibiscus aethiopicus var. *ovatus*																2	2	2	
Pearsonia aristata (Fb)																	3	2	
Sonchus integrifolius (Fb)																1		3	
Helichrysum subulifolium (Fb)															2			2	
Tristachya leucothrix (Gr)				2												1	3		2
Senecio latifolius (Fb)									3						1		3	2	2
Triumfetta welwitschii var. *hirsuta* (Fb)																3		2	3

(11) Differential species of the *Hypoxis multiceps–Wahlenbergia huttonii–Eragrostis racemosa* Variant (49A)

Species	195	198	199	136	63	62	84	71	73	82	77	78	76	85	88	89	93	90	91
Scabiosa columbaria (Fb)															4	2			
Hypoxis multiceps (Fb)															3	3			
Gladiolus sp. (Fb)		1													2	2			
Rhynchosia totta (Ln)															2	2			

+ Denotes presence. Digits 1–9 in matrix denote Domin-Krajina cover-abundance values. Growth forms: Tr = tree; Sh = shrub; Ln = lianoid; Fb = forb or herb; Cy = sedge; Gr = grass; Pt = fern.

TABLE 1.—Floristic classification and habitat correlation in Grassland of the Humid Mistbelt, Sabie Area (from Deall 1985) (continued)

Habitat factors	Community number	45				46		47			48					49 A		49 B		
	Relevé number	195	198	199	136	63	62	84	71	73	82	77	78	76	85	88	89	93	90	91
	Total species per relevé	32	27	22	40	46	40	31	51	38	44	39	39	28	30	41	40	44	35	41
(12) Differential species of the *Parinari capensis* subsp. *capensis–Wahlenbergia huttonii–Eragrostis racemosa* Variant (49B)																				
Raphionacme elata (Fb)																		2		3
Sphenostylis angustifolia (Ln)																		3		3
Piloselloides hirsuta (Fb)									2									1	2	
(13) Differential species of Communities 46–49																				
Becium obovatum (Fb)						2	2			2	3	5	2	4		3			3	
Indigofera sanguinea (Fb)										4		2	2			3	3	2		
(14) Differential species of Communities 45–49																				
Haplocarpha scaposa (Fb)		2	2			3	4	2	3		3	2	3			3	2	3	4	

\+ Denotes presence. Digits 1–9 in matrix denote Domin-Krajina cover-abundance values. Growth forms: Tr = tree; Sh = shrub; Ln = lianoid; Fb = forb or herb; Cy = sedge; Gr = grass; Pt = fern.

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PLANT COLLECTING APPARATUS FOR TAXONOMIC AND ECOLOGICAL STUDIES

1. A LIGHTWEIGHT PLASTIC PLANT PRESS FOR ON-SITE SPECIMEN PRESSING

The advantages of pressing plant specimens on-site, while fresh, are: 1, a natural layout may be achieved that can often resemble the original plant habit; 2, the specimen forms a site record rather than a reconstruction of a site record; 3, fresh material is often easier to arrange than wilted material; 4, it increases sampling efficiency because only sufficient material to fill the required number of herbarium sheets need be collected, and 5, it reduces information loss through a reduction in specimen handling.

Factors which can inhibit on-site plant pressing include the difficulty in carrying plant presses in the field and pressing plant specimens in even moderate wind. The following is a description of an economical and portable plant press that can be used on-site, even in windy conditions.

A rectangular plastic bin, with stacking base design for rigidity, and dimensions of 490 × 260 × 240 mm forms the basic unit. These are available commercially. The sides can be cut to a convenient depth. A depth of 115 mm provided a reasonable compromise between bulkiness and capacity. Four slots are cut in the angle between the base and the long side as illustrated in Figure 1, for press strap insertion. The two press straps are each 25 × 1 300 mm nylon straps with double D-rings on one end. The straps can be secured to the bottom of the bin by rivets so that the D-ring side of the strap is slightly longer than the bin

FIGURE 1.—Portable press with shoulder strap showing strap layout and spare specimen folders secured inside lid.

FIGURE 2.—Portable press mounted on rucksack frame with additional pockets for equipment.

depth. Figure 1 shows the inside of the plant press with press straps and shoulder strap which is attached to the bottom of the bin by rivets.

The lid which is also available commercially is cut to fit snugly inside the press. A nylon strap can be riveted to one face of the lid to form a handle. Two loops of elasticized straps of 25 mm width are riveted to the lid for holding spare specimen folders on the face opposite to that with the handle (Figure 1).

In use, folders are numbered prior to pressing, while still held down by the elasticized straps as the lid also forms a good writing surface. If the end of the press strap is looped before threading through the second D-ring then the free end becomes a quick-release device to facilitate press opening. The press can be used either with a shoulder strap (Figure 1) or it can be mounted on a rucksack frame (Figure 2). The former is often more suitable for ecological studies where an abundance of equipment often necessitates a separate rucksack.

The portable press is not suitable for drying specimens, therefore drying paper is not required. Specimens should be transferred to drying presses with drying paper inserted between each folder as soon as possible. The portable press protects specimens from moist vegetation and light rain. The press sides afford protection from wind when laying out specimens and clothes pegs can be used to keep folder covers open, if necessary. The sides also ensure that the specimens are not subjected to undue shifting such as is often experienced when loading and aligning standard presses. Pressing of fresh material before transfer to a standard drying press also facilitates alignment of specimen folders.

Use of a portable press should improve the quality and information content of plant specimens.

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2. COLDAT: A FIELD-DATA CAPTURE PROGRAM FOR COLLECTOR'S DATA AND HERBARIUM LABELS

A plant specimen is rarely worth preserving unless the place and time of collection and the collector, preferably with a collecting number, are known. Information concerning the habitat and plant characteristics, not evident in the dried specimen, can enhance the value of a specimen considerably.

Initial recording of observations relevant to herbarium specimens should be recorded at the place and time of collection. However, the occurrence of errors and hence the reliability of the data, can be considerably influenced by the number of times the data are manually transferred, from initial recording, to the herbarium label. Writing herbarium labels for more than one specimen from a particular collecting site entails much duplication as only the plant characteristics and specimen numbers change. It should, therefore, not be necessary to record all data for each label, at a site, thereby saving on high-cost field time. Insertion of data at a later stage may lead to errors.

Computerized field-data capture can facilitate on-site data recording, overcome the problem of duplicating data and eliminate manual data transfer. The program

```
RH WESTFALL     Coll no:  105
Specimen no:  2288
Grid ref: 2428AC  Region: Transvaal
Date: 1987/11/14
Maj loc: WATERBERG
Min loc: VAALWATER
Prec loc: 242134S280744E FARM WOLVEN
FONTEIN
Altitude:  1180 m  Aspect: NE
Life form: Climber
Plant height:  10 cm
Habitat
 SHORT CLOSED WOODLAND ON SANDY ROCK
Y SOILS.GENTLE SLOPE ON INTERFLUVE.
Plant notes
 CREEPER WITH PURPLE FLOWERS AND TUB
ER.
Loc/Rel no:  870041  Bio effects: 10
Veg type:  7  Substrate:  2
Moist reg:  2  Soil type:  2
------------------------------------
PLANT NAME:


------------------------------------
```

FIGURE 3.—Mini label for collector's register with provision for later insertion of plant name.

```
    BOTANICAL RESEARCH INSTITUTE, SOUTH AFRICA
-----------------------------------------------

          2428AC Grid ref. Regio Transvaal
   RH WESTFALL Legit      Anno  1987/11/14
          2288 No.        Alt.  1180 m
Name


Locality:
WATERBERG  VAALWATER
242134S280744E FARM WOLWENFONTEIN
Habitat:     Aspect: NE
SHORT CLOSED WOODLAND ON SANDY ROCKY SOILS. GENTLE
 SLOPE ON INTERFLUVE.
Notes:  Climber  10 cm
CREEPER WITH PURPLE FLOWERS AND TUBER.
                   Det. I Ref.
-----------------------------------------------
Bio.eff. 10 Veg. type 7 Substrate 2
Moisture reg. 2 Soil type 2 Loc.no. 870041
-----------------------------------------------
```

FIGURE 4.—Herbarium label from mainframe printer after computerized data transer to B7900 computer.

COLDAT, written in BASIC for the Sharp PC1500A pocket computer is designed for field-data capture of herbarium label data, data transfer and label production.

Data input provides for the following: collector's name and number; region; grid reference; date; major, minor and precise localities; locality or relevé number; aspect; altitude; PRECIS (Morris & Glen 1978) codes for biotic effects, vegetation type, substrate, moisture regime and soil type; habitat notes; specimen number; plant height; PRECIS (Morris & Glen 1978) life-form code; and plant characteristic notes. Complete data are entered for the first label, thereafter, only data that change are entered. Specimen numbers are allocated automatically after the first number. Mini labels (Figure 3) can be printed in the field. They form the original hard copy of the data and can be pasted into a book to form a collector's register. Provision is made on the mini labels (Figure 3) for later insertion of plant names. Data are transferred to cassette before the computer capacity of 40 labels is reached.

Data transfer from cassette to a host computer can be achieved with a suitable program. The program COLTRAN written in BASIC for the Sharp PC1500A pocket computer transfers data from cassette to the Burroughs B7900 mainframe computer. The transfer format required is the same as that used for printing large format labels (Figure 4) on the mainframe printer. The data can then be transferred to a data bank.

This procedure permits minimum data input and physical data handling with consequent increase in data reliability. Experience has shown that minimum data input leads to a greater concentration on plant characteristics and habitat recording on-site, with a corresponding increase in quality of herbarium label information, compared to manual methods used previously.

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3. A NEW TOP-LOADING PLANT PRESS FOR OFF-SITE SPECIMEN PRESSING

Correct alignment of specimen folders and drying papers when pressing plants reduces specimen damage caused by specimen-folder shift and increases the functional life span of specimen folders and drying papers through a reduction of friction and edge-wear. It is, furthermore, often difficult to close a standard strap-type plant press without causing folder shift especially when uneven plant specimens are pressed. The potential for specimen damage is increased with the insertion of additional specimens, windy conditions and the necessity for changing drying papers. The procedure for pressing plants with a standard strap-type plant press can be laborious and often frustrating.

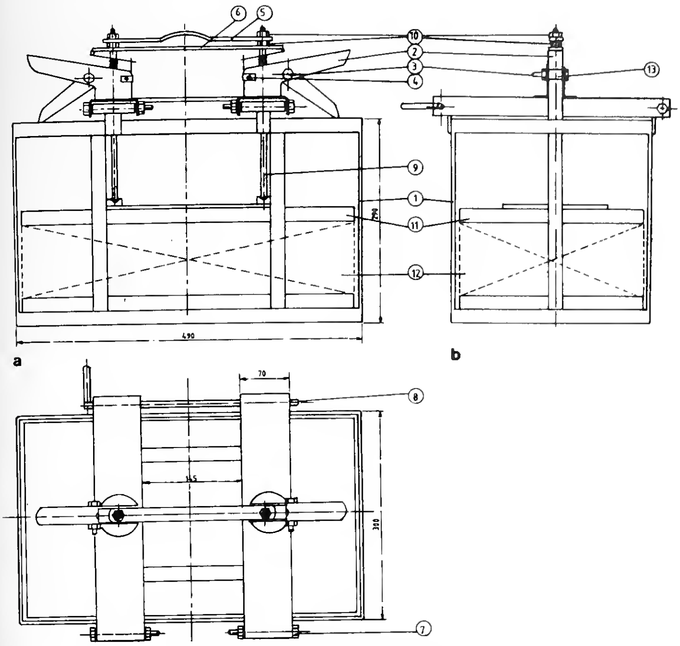
The plant press shown in Figures 5 and 6 minimizes specimen-folder shift, even with bulky specimens and is easy to use. The features (Figure 5) include:

1, a top which is hinged by means of two nuts and bolts (item 7) for loading and access to plant specimens while in the press;
2, a steel frame (item 1) which provides alignment guides for correct alignment of specimen folders and drying paper;
3, quick pressure release with the spring release bar (item 6) and release mechanism (item 5);
4, rapid opening and closing of the hinged top with locking pin (item 8); and
5, a simple and effective pressure mechanism, using modified silicone caulking guns (item 2).

The double pressure action provided by the two caulking guns and the swivel action of the pressure plate (item 11) allows for even pressure to be applied to uneven specimens. Pressure is applied by squeezing the caulking gun handles. In use, only two fingers need be used on each handle to exert a pressure of about 80 kg on the plant specimens. Pressures greater than 80 kg could damage plant specimens.

The mass of the empty top-loading plant press is about 12 kg which inhibits movement of the press in the vehicle but can preclude on-site use. The use of a portable press (Panagos & Westfall 1989a) is recommended whenever collecting outside the immediate vicinity of the collector's vehicle. Specimen folder transfer and drying paper insertion are extremely simple and quick when a portable press is used.

String or ribbon can be draped inside the top-loading plant press prior to loading (Figure 6). The specimen



MATERIALS

ITEM NO.	QUANTITY	DESCRIPTION	REMARKS
1.	1	Frame - Soft steel	20x5mm
2.	2	Silicone caulking gun	2mm
3.	2	Reinforced by low C steel	M-6 bolt
4.	2	Reinforced	1mm
5.	1	Release mechanism	20x5mm
6.	1	Spring release	20x5mm
7.	2	Bolt and nut	M-8
8.	1	Locking pin	Φ8
9	2	Pressure rod	Φ8
10	4	Lock nuts	M-8
11.	2	Pressure plate - wood	470x280x20
12.		Plant material and drying paper	
13	2	Reinforcing rod	Φ10

FIGURE 5.—Plan of top-loading plant press with materials required (a) side view; (b) end view and (c) top view.

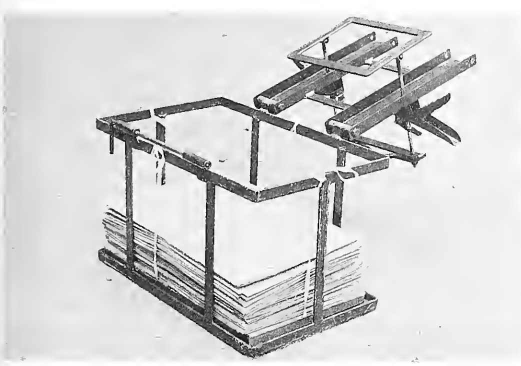


FIGURE 6.—Open top-loading plant press showing draped ribbons for batch removal of plant specimens.

folders can then be tied and removed in a batch when required, minimizing specimen handling and obviating the need to remove the top-loading plant press from the vehicle.

Use of the top-loading plant press can reduce information loss through specimen damage and time spent on pressing specimens, as well as increase the life span of specimen folders and drying paper. It can even be used in windy conditions.

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4. DRIER-TRANSPORTERS FOR PLANT PRESSES

Extended plant collecting trips necessitate frequent changes of drying paper to prevent plant specimens becoming mouldy. This, together with vehicle interior space limitations, which can lead to frequent plant press restacking, can cause specimen damage. Changing drying paper is also time-consuming. Plant presses transported outside the vehicle can allow better interior space utilization and the method can include a specimen drying function not possible inside the vehicle.

A fully enclosed aluminium rack, mounted on the roof of a NISSAN long wheelbase Ekonovan, is shown in Figure 7. The roofrack is suitable for 12 standard strap-type plant presses, filled up to about 350 mm in height. Plant presses are loaded through four side-flaps and are secured by straps in guides which ensure airflow around each plant press. The end-flaps can remain open, even when travelling, for ventilation. In moist or dusty conditions the end-flaps can be closed. The exterior is painted black for heat absorption, to assist the drying process. The drying process is, however, not even throughout the roofrack as the four front presses have a markedly faster drying rate than the others when the vehicle is moving.

FIGURE 7.—Roofrack drier-transporter showing open front and side flaps and stowed canvas awning on awning pole box.

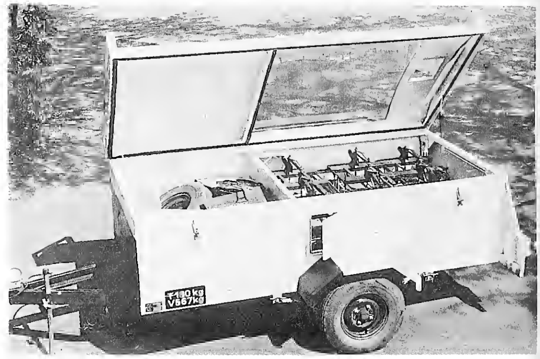

FIGURE 8.—Trailer drier-transporter showing open ventilators, perspex lid and top-loading plant presses.

A partitioned 2,12 m trailer with a perspex lid over the rear partition for light transmission and heat capture is shown in Figure 8. A large ventilator on each of the sides, the tailgate and the rear of the lid ensure adequate ventilation when stationary and, forced ventilation when moving. The lid and a side ventilator, in the open position, can be seen in Figure 8. The front partition can be used to stow camping gear. This configuration is suitable for six top-loading plant presses (Westfall *et al.* 1989). Both partitions have webbed rubber mats for floor protection and insulation.

In later models the rear lid was made of metal and painted black for heat absorption as the perspex, apart from being expensive, is inclined to crack. This did not influence internal temperatures significantly as temperatures of about 53°C at 1 700 m altitude were recorded in both models when cloud cover was absent. The perspex model did, however, appear to have a faster rate of heat buildup than the painted model.

The roofrack drier-transporter should dry plant specimens more efficiently because considerably more air can pass over the plant presses than in the trailer. However, in inland summer conditions, the trailer has proved adequate for specimen drying, eliminating the need to change drying paper in all but the wettest specimens, such as geophytes with large, moist storage organs. In comparison with the trailer, the roofrack has the following disadvantages: 1, loading and unloading of plant presses is difficult; 2, plants cannot be pressed with the press *in situ*; 3, noticeably higher fuel consumption, especially with speeds in excess of 90 km/h; 4, altered vehicle handling characteristics; and 5, higher manufacturing cost.

The plant-press securing straps of the roofrack can be used to take up slack in the plant presses as the material dries. The roofrack is also equipped with a canvas awning on an awning pole box, with width almost that of the roofrack length and length sufficient to pass over the open door and reach the ground. The awning is rolled and stowed on the side of the roofrack as shown in Figure 7. The trailer lid can also offer some protection from inclement weather when raised, as shown in Figure 8.

The trailer drier-transporter, although possibly slightly less efficient than the roofrack drier-transporter for drying plant specimens, can reduce plant-press handling considerably, thereby saving time and possible information loss through specimen damage.

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5. A GAS DRIER FOR FIELD DRYING OF PLANT SPECIMENS

The use of a portable specimen drier can overcome the necessity for changing drying paper either when plant specimens are too moist for drying in a drier-transporter (Panagos & Westfall 1989b) or when working in very humid conditions. Characteristics of a portable specimen drier should include: (a) robust construction; (b) efficient drying; (c) suitability for drying specimens in plant presses; (d) simple and inexpensive construction; and (e) independence of electrical power. These characteristics exclude specimen driers such as that described by Botha & Coetzee (1976), in which gas lamps are used as heat sources, because of the fragility of the mantles. Furthermore, aluminium construction is expensive in terms of both material and labour.

In designing a portable specimen drier, maximum use was made of commercially available apparatus in order to reduce material and labour costs. A Cadac Skottelskaar Braai forms the basic unit. Modification simply entails the following:

FIGURE 9.—Specimen drier showing (a) press support unit, (b) burner pan, (c) stem, (d) gas cylinder stabilizers, (e) 2,8 kg gas cylinder and (f) retaining clip handles wedged on the gas cylinder.

1, removing the cooking dish;
2, reducing the stem to an overall length of 155 mm (excluding jet protrusion) by cutting, for stability;
3, replacing the standard jet with a Cadac no. 31 (0,12 mm) jet for heat reduction;
4, placing rubber tubing over the retaining clip handles so that the handles can be wedged against the gas cylinder for extra stability; and
5, drilling five 11 mm diameter holes in the base of the burner pan in the same contour as the three existing holes for increased airflow.

Air heating, press support and flame deflection are provided by a simple unit placed on the burner pan for supporting the press.

This unit consists of a flat expanded metal grid 520 mm in diameter with the following specifications: 2,5 mm strand width; 1,6 mm strand thickness; mass 9,1 kg m^{-2}; and 21% opening. The grid serves to heat the air and also prevents gas ignition on the upper side of the grid, as in a Davy lamp. A ring of 10 mm diameter rod is brazed on the upper side of the grid around the circumference, to provide a smooth edge and increase rigidity.

The plant press is supported by a 370 × 370 mm square of 10 mm diameter rod. Four struts, also of 10 mm diameter rod, are brazed to the corners of the square and to the grid circumference rod, to support the plant press 105 mm above the grid.

To prevent the grid centre from overheating, the flame is deflected by a 55 mm deep, lipped cone and a 6 mm thick plate both of fibre-reinforced cement and with a diameter of 275 mm. These are bolted to the underside of the grid. A fibre-reinforced cement ashtray lid is suitable for the cone and can withstand temperatures of up to about 200°C.

A 550 × 1 960 mm canvas skirt, with eyes at 100 mm intervals along the edge of one side for threading a securing cord, channels air through the grid and press.

The assembled field drier mounted on a 2,8 kg gas cylinder is shown in Figure 9. Assembly entails screwing the stem into the gas cylinder and placing the burner pan onto the stem and the press support unit onto the burner pan. The retaining clip handles are then wedged onto the cylinder. The cylinder can be stabilized by the addition of gas cylinder stabilizers as shown in Figure 9. Calculations indicate a burning time in excess of 120 hours with a 2,8 kg gas cylinder as shown in Figure 9.

After lighting through the large burner pan holes and adjusting the flame to a low setting, the plant press is placed with the long side on the press support unit in such a way that the hot air can rise through the plant press cardboard ventilators and between the drying papers. The canvas skirt is wrapped around the press and secured with the cord as shown in Figure 10. Some excess hot air should be able to pass between the press and skirt to prevent overheating.

FIGURE 10.—Specimen drier with plant press showing the canvas skirt wrapped around the plant press.

After use a plastic cap should be placed over the jet and a plug inserted into the open end of the stems, to prevent jet clogging. The components can then be wrapped in the canvas skirt for transportation.

The specimen drier is robust, extremely efficient, simple to construct and easy to transport.

ACKNOWLEDGEMENTS

The authors thank Dr B. de Winter, Mr T.H. Arnold, Dr J.C. Scheepers and Mr J.M. van Staden for suggestions and assistance.

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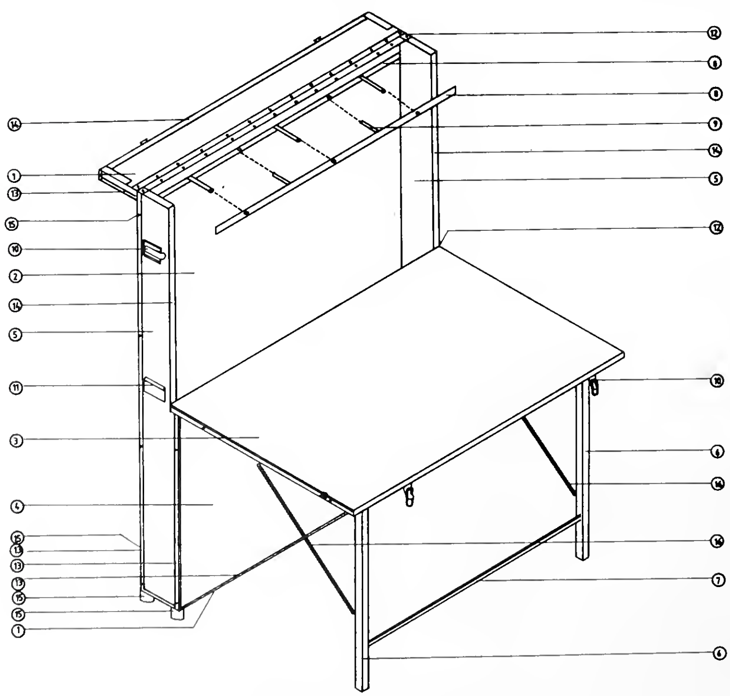
6. A TRANSPORTABLE MAP CABINET FOR VEHICLE AND OFFICE USE

The simplest reference for collecting or sample site locality is the grid system of parallels and meridians, used throughout the world, and is the most common of co-ordinate systems (Strahler 1975). This grid system is also used on the South Africa 1:50 000 sheets which, because of scale convenience, are frequently used for determination of site locality.

The precision with which site localities are determined can influence 1, subsequent mapping precision; 2, re-collecting or re-sampling efficiency; 3, re-sampling validity; and 4, validity of correlations with other sources.

In field situations, it is often impracticable to determine positions on a map with greater precision than the nearest millimetre. This implies a ground error of less than, or equal to 25 m at 1:50 000 scale. It is, therefore, not necessary under these circumstances, to record a locality with a precision greater than the nearest second, which implies a ground error of less than 16 m. This level of precision can be considered adequate for much plant collecting and vegetation sampling work. Fluctuating humidity with consequent stretch and shrinkage of maps should not significantly alter this level of precision because of proportionality. However, the method of map transportation, including folding, rolling and subjection to impacts can cause considerable map distortion, often with irregular loss of precision.

These causes of precision loss can be overcome with a vertical map filing cabinet. A multi-prong map-support system, for use with pre-punched tape on the maps, facilitates indexing, filing and retrieval. This system is used in the map cabinet shown in Figure 11. Maps are supported



MATERIALS

ITEM NO.	QUANTITY	DESCRIPTION	REMARKS
1	1 each	Top and base (blockboard)	940x125x16
2	1	Back (plywood)	1205x940x3
3	1	Working surface (blockboard)	940x595x16
4	1	Front (plywood)	940x605x3
5	2	Sides (blockboard)	1205x125x16
6	2	Legs (square tubing)	605x16x16
7	1	Strut (square tubing)	760x12x12
8	2	Flat iron	890x25x6
9	5	Metal prongs	ϕ 7mm 80mm long
10	4	Throw over catches	55mm long 15mm wide
11	2	Handles	80mm long 35mm wide
12	2	Piano hinges	940 mm 30mm wide
13		Aluminium corner strips	
14		Sponge rubber strips	25mm wide
15	8	Rubber door stops	ϕ 35mm
16	2	Chains	480mm

FIGURE 11.—Plan of portable map cabinet with list of materials required.

FIGURE 12.—Portable map cabinet in vehicle with front flap down to form a working surface. Note opissometer (a), attached with spring clips, for measuring distance.

by five metal prongs, three of which are attached to a fixed flat iron bar and two of which are attached to a removable bar for map retrieval. Holes drilled in the bars opposite each prong allow support for the removable bar and simplify map retrieval and filing. The removable bar is held in place by the front flap when in the closed position. The front flap also serves as a large working surface and is supported by fold-down legs when open.

The map cabinet has a net mass of about 20 kg and a capacity of over 100 maps. It can be carried by one person and is suitable for use in a vehicle such as is illustrated in Figure 12. Map storage and transport as well as site location and plotting in the field are greatly facilitated with the use of this map cabinet.

ACKNOWLEDGEMENTS

The authors thank Dr J.C. Scheepers and Mr J.M. van Staden for suggestions and assistance.

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7. A TRANSPORTABLE CAMPING KITCHEN FOR VEHICLE USE

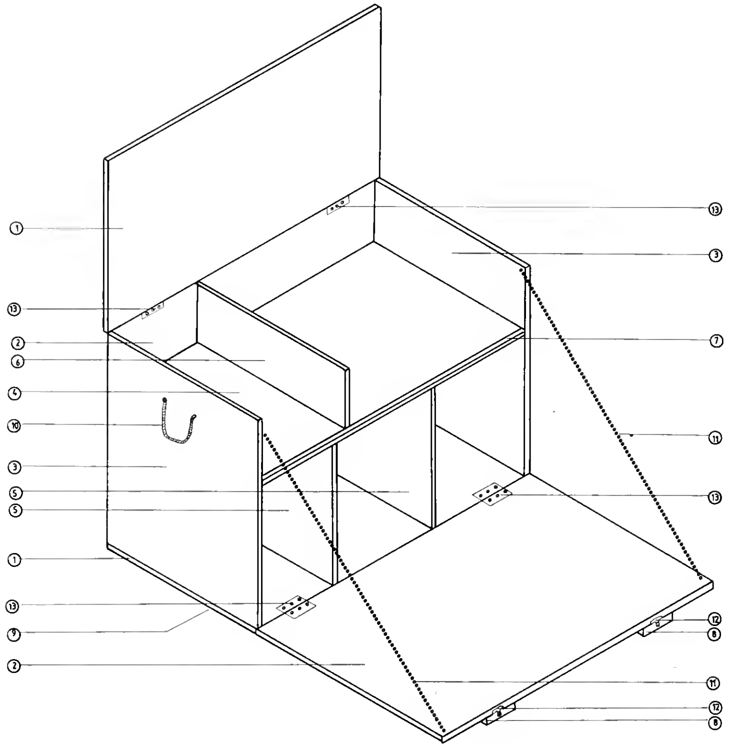
A considerable saving of time and vehicle space can be effected by making use of efficient provisioning equipment. A simple, sturdy, transportable camping kitchen suitable for 8/12-seater light bus is shown, as well as a standing basin which is very useful in situations where a single camp site is used (Figure 13).

The upper partitioned area is for food, to which easy access can be gained through the upper lid (Figure 14). The lower partitioned area is suitable for 2,0 × 2,8 kg gas bottles with burners, plastic cooler box and eating, cooking and cleaning utensils. The front lid also serves as a working surface.

The capacity of the camping kitchen unit is sufficient for utensils and food for three to four people, for up to two weeks. Exterior dimensions are such that the unit can be positioned behind the rear seat with access through the rear door of the light bus. The unit is best filled while in position as the laden mass inhibits movement. The spare wheel should be removed from the side panel and can be placed under the rear seat because of restricted access with the laden unit. The working surface support chains can be covered with cycle tubes as chain covers (Figure 14) to suppress rattles when the vehicle is in motion. Sufficient space exists between the unit and side panel of the vehicle for a 20ℓ plastic water container. This should be equipped with an extension tube and tap for easy access to water during food preparation.

Stainless steel cooking and eating utensils, which experience has shown are easier to clean than aluminium, can be obtained economically from mine suppliers. The

FIGURE 13.—The camping kitchen positioned in the rear of a light bus showing working surface, water container and standing basin.



MATERIALS

ITEM NO.	QUANTITY	DESCRIPTION	REMARKS
1	1 each	Top and base (clear pine)	950x520x25
2	1 each	Back and work surface (clear pine)	950x630x25
3	2	Sides (clear pine)	630x520x25
4	1	Shelf (clear pine)	950x520x25
5	2	Long divider (clear pine)	520x400x25
6	1	Short divider (clear pine)	520x180x25
7	1	Beading (clear pine)	900x25x25
8	2	Work surface re-inforcing (clear pine)	630x100x25
9	2	Base re-inforcing (clear pine)	520x100x25
10	2	Rope handles	350mm ø7
11	2	Chains and chain covers	560mm
12	2	Throw over catches	75mm long 25mm wide
13	4	Hinges	75mm

FIGURE 14.—Plan for transportable camping kitchen listing materials required.

pan unit of a CADAC minibraai was also found to dissipate heat from the gas burner evenly over thin-bottomed pots, thereby preventing food from burning. Some protection from light rain, during food preparation is afforded by the vehicle's open rear door. A 12V fluorescent tube with socket for the vehicle's cigarette lighter receptacle can provide sufficient light for meal preparation and also for work within the vehicle.

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New taxa, new records and name changes for southern African plants

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ABSTRACT

Alterations to the inventory of about 24 000 species and infraspecific taxa of bryophytes and vascular plants in southern Africa are reported for the year 1988. The inventory, as currently maintained in the Taxon component of the PRECIS system, contains the accepted name for each taxon, synonyms previously in use as accepted names during the past half-century, and literature references necessary to identify species in each genus and to establish the synonymy. The inventory is updated as new research affecting plant classification in southern Africa is published. During 1988 there were 744 alterations, affecting about 3% of the total number of taxa.

UITTREKSEL

Daar word vir die jaar 1988 verslag gedoen van veranderings aan die lys van ongeveer 24 000 spesies en infraspesifieke taksons van mosse en vaatplante in suidelike Afrika. Die lys, soos dit tans in die Takson-komponent van die PRECIS-stelsel in stand gehou word, bevat die aanvaarde naam van elke takson, sinonieme voorheen in gebruik as aanvaarde name gedurende die afgelope halfeeu, en literatuurverwysings wat nodig is om spesies in elke genus te identifiseer en om sinonieme vas te stel. Die lys word bygewerk soos nuwe navorsing wat plant-klassifikasie in suidelike Afrika raak, gepubliseer word. Gedurende 1988 was daar 744 veranderinge wat ongeveer 3% van die totale aantal taksons verteenwoordig.

INTRODUCTION

This is the fifth in this series that reports annual alterations to the complete inventory of southern African plants maintained in the Taxon component of the computer system PRECIS. References to the first three of these lists are given in the introduction to the fourth (Gibbs Russell *et al.* 1988). The format continues to be that used in previous lists of the series. The complete and up-to-date listing of names, literature and useful synonyms for all the 24 000 southern African plants is continuously maintained in the Taxon component of PRECIS, and the plant identification service of the Botanical Research Institute uses the names as currently recorded. The Institute can supply PRECIS listings of the most recent species treatment for any family or genus. In addition the data files for the alterations reported in this series have been available on floppy disk in MS-DOS or BTOS format since 1988.

This year, as in 1985 and 1988, alterations for all plants have been included. In 1986 and 1987, while the literature and synonyms for dicotyledons were being completed, only cryptogams and monocots could be covered in these annual lists. A total of 744 changes were recorded during 1988, affecting about 3% of the total number of taxa in the southern African flora.

The largest number of name changes is to be found in genera in which active taxonomic research is in progress, or for which revisions have recently been published. One of the most extreme examples of this is the genus *Indigofera*, where we record changes in 272 records (about 50% change). Because of the extent of the changes in this genus, we break with the tradition of presenting only name changes in these lists, and list *Indigofera* in full.

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This list covers name changes recorded since the previous list went to press, and includes material received before the end of February 1989. Due largely to postal delays, therefore, this indicates that name changes published in overseas journals after November 1988 will only appear in next year's list. Over 120 journals are routinely scanned for relevant papers, and the changes reported here were published in about 170 papers and books.

Extensions being tested at present to Specimen- and Taxon-PRECIS and the curatorial data base (Arnold in press) mean that in future each name change will need to be entered into the computer systems of the National Herbarium only once. The full implementation of these extensions will mean a drastic reduction in the effort required to keep PRECIS up to date, and an improvement in the overall standard of accuracy of the names in our data bases. We welcome reports of changes from botanists outside the Botanical Research Institute.

Spermatophyte families and genera follow the order and numbering of the Englerian classification system as given by Dyer (1975, 1976), with extensions to accommodate new genera as described in detail by Morris & Glen (1978). The only exception is the family Poaceae, which follows an unpublished system of generic numbering. Bryophytes follow Crosby & Magill (1981) and Grolle (1983). Pteridophytes follow Schelpe & Anthony (1986). Species are listed in alphabetical order: a name in current use appears in upper case letters with its PRECIS number, synonyms appear in lower case. Each synonym is entered twice, once indented below the name for which it is a synonym and once in its alphabetical place in the genus. New collection records are indicated by quoting a specimen and its locality. Naturalized taxa are shown by an asterisk following the name. A few names have been included because the author name or publication date have to be changed; with most of these names the reason for inclusion is not specifically mentioned.

BRYOPHYTA Contributed by J. van Rooy

HEPATICAE 1000

RICCIACEAE (H8) 1016

1016 -RICCIA L.
1. HDWE. 1898. BULL. TORR. BOT. CLUB 25: 184.
7. JOVET-AST. 1983. CRYPTOGAMIE 4,1: 37.
8. VOLK & PEROLD. 1984. BOTHALIA 15, 1 & 2: 117-124.
9. VOLK & PEROLD. 1985. BOTHALIA 15, 3 & 4: 531-539.
10. VOLK & PEROLD. 1986. BOTHALIA 16,1: 29-33.
11. VDLK & PEROLD. 1986. BOTHALIA 16,2: 169-201.
12. PEROLD & VOLK. 1988. BOTHALIA 18,1: 37-49.
13. VOLK & PEROLD. 1988. BOTHALIA 18,2: 155-163.
14. PEROLD. 1989. BOTHALIA 19,1.
50 R. ALATOSPORA VOLK & PERDLD
100 R. ALBOLIMBATA S. ARNELL
(=R. albosquamata S. Arnell) 14
225 R. ALBOPOROSA PEROLD
250 R. ALBORNATA VOLK & PEROLD
300 R. albosquamata S. Arnell = R. ALBOLIMBATA
450 R. ARGENTEOLIMBATA VOLK & PEROLD
650 R. CAMPBELLIANA HOWE
700 R. canescens Steph. = R. TRICHOCARPA
800 R. capensis Steph. = R. LIMBATA
1050 R. CONGOANA STEPH.
(=R. rhodesiae S. Arnell) 11
1550 R. DUTHIEAE VOLK & PERDLD
1750 R. HIRSUTA VOLK & PEROLD
1800 R. LIMBATA BISCH.
(=R. capensis Steph.) 12
1850 R. MAMMIFERA VOLK & PEROLD
1875 R. MICROCILIATA VOLK & PEROLD
1950 R. MONTANA PEROLD
2050 R. NIGRELLA DC.
2150 R. PARVOAREOLATA VOLK & PEROLD
2200 R. PERSSONII KHAN
(Note spelling correction)
R. rhodesiae S. Arnell = R. CONCOANA
2750 R. ROSEA VOLK & PEROLD
2950 R. SCHELPEI VOLK & PEROLD
3250 R. TRICHOCARPA HOWE
(=R. canescens Steph.) 7

MUSCI 1301

POTTIACEAE (14) 1401

1404 -BARBULA HEDW.
B. trichostomacea C. Muell. = DIDYMODDN AUSTRALASIAE

1406 -DESMATODON BRID.
2. TOWNSEND. 1987. LINDBERGIA 12: 67-71.
50 D. BOCOSICUS C. MUELL.

1407 -DIDYMODON HEDW.
1. MAGILL. 1981. FSA.
2. ZANDER. 1978. PHYTOLOGIA 41,1: 11-32.
3. CUERRA & ROS. 1987. CRYPTOGAMIE 8,1: 64.
100 D. AUSTRALASII (HOOK. & GREV.) ZANDER
(=Barbula trichostomacea C. Muell.) 1
(=Trichostomopsis australasiae (Hook. & Crev.) Robinson) 2
550 D. TRIVIALIS (C. MUELL.) GUERRA
(=Trichostomopsis trivialis (C. Muell.) Robinson) 3

1430 -Trichostomopsis Card. = DIDYMODON
T. australasiae (Hook. & Grev.) Robins = DIDYMODON AUSTRALASII
T. trivialis (C. Muell.) Robins = DIDYMODON TRIVIALIS

GRIMMIACEAE (15) 1441

1441 -CRIMMIA HEDW.
C. nigroviride C. Muell. var. robusticulum (C. Muell.) Par. = RACOMITRIUM LAMPROCARPUM

1442 -RACOMITRIUM BRID.
2. OCHYRA ET AL. 1988. BULL. JARD. BOT. NAT. BELG. 58: 225-258.
R. defoliatum Oix. = R. LAMPROCARPUM
300 R. LAMPROCARPUM (C. MUELL.) JAEC.
(=Crimmia nigroviride C. Muell. var. robusticulum (C. Muell.) Par.) 2
(=R. defoliatum Dix.) 2
(=R. nigro-viride (C. Muell.) Par.) 2
(=R. pseudoacicularis (C. Muell.) Par.) 2
R. nigro-viride (C. Muell.) Par. = R. LAMPROCARPUM
R. pseudoacicularis (C. Muell.) Par. = R. LAMPROCARPUM

BRYACEAE (24) 1506

1508 -BRYUM HEDW.
100 B. ALPINUM HUDS. EX WITH.
(Note change in species number)

ORTHOTRICHACEAE (42) 1616

1618 -MACROMITRIUM BRID.
2. MAGILL & VAN ROOY. MS. FSA.
M. schlotheimiaeformis Par. = CARDOTIELLA SECUNDA
M. secundum C. Muell. = CARDOTIELLA SECUNDA
500 M. SERPENS (HOOK. & CREV.) BRID.
(=M. tristratosum Dix.) 2
M. tristratosum Dix. = M. SERPENS

1620 -SCHLDTHEIMIA BRID.
2. MACILL & VAN ROOY. MS. FSA.
S. exrugulosa C. Muell. = S. RUFOPALLENS
100 S. FERRUGINEA (HOOK. & CREV.) BRID.
(=S. subventrosa Broth. & Bryhn) 2
425 S. RUFOGLAUCA C. MUELL.
450 S. RUFOPALLENS C. MUELL.
(=S. exrugulosa C. Muell.) 2
S. subventrosa Broth. & Bryhn = S. FERRUGINEA

1622 -ZYCODON HODK. & TAYL.
2. MAGILL & VAN RODY. MS. FSA.
Z. africanus Sim = Z. EROSUS
300 Z. EROSUS MITT.
(=Z. africanus Sim) 2
500 Z. LEPTOBOLAX C. MUELL.
(=Z. transvaaliensis Rehmann ex Sim) 2
550 Z. PERREFLEXUS C. MUELL.
Z. transvaaliensis Rehmann ex Sim = Z. LEPTOBOLAX

1623 -CARDOTIELLA VITT
2. MACILL & VAN ROOY. MS. FSA.
100 C. SECUNDA (C. MUELL.) VITT
(=Macromitrium schlotheimiaeformis Par.) 2
(=Macromitrium secundum C. Muell.) 2

RHABDOWEISIACEAE (42A) 1631

1632 -RHABDOWEISIA B.S.G.
2. MAGILL & VAN ROOY. MS. FSA.
50 R. CRISPATA (WITH.) LINDB.

POLYTRICHACEAE (83) 1921

1922 -POGONATUM BEAUV.
2. FANSHAWE. 1980. POLYTRICHACEAE. M.SC. UCT.
50 P. BORCENII (HAMPE) JAEC.
100 P. CAPENSE (HAMPE) JAEG.
(=Polytrichum transvaaliense C. Muell.) 2
300 P. OLICODUS (C. MUELL.) MITT.
(=Polytrichum natalense Sim) 2

1923 -POLYTRICHUM HEDW.
2. FANSHAWE. 1980. POLYTRICHACEAE. M.SC. UCT.
100 P. COMMUNE HEDW.
(=P. commune Hedw. var. trichodes (C. Muell.) Dix.) 2
P. commune Hedw. var. trichodes (C. Muell.) Dix. = P. COMMUNE
P. formosum Hedw. = POLYTRICHASTRUM FORMOSUM
P. natalense Sim = POGONATUM OLIGODUS
P. transvaaliense C. Muell. = POGONATUM CAPENSE

1924 -Psilopilum Brid. Southern African species moved to OLIGOTRICHUM
2. FANSHAWE. 1980. POLYTRICHACEAE. M.SC. UCT.
P. afrolaevigatum Dix. = OLIGOTRICHUM AFROLAEVIGATUM
P. wageri Broth. in Dix. = OLIGOTRICHUM WAGERI

1925 -OLIGOTRICHUM LAM. & DC.
1. FANSHAWE. 1980. POLYTRICHACEAE. M.SC. UCT.
50 O. AFROLAEVICATUM (DIX.) C.L. SMITH
(=Psilopilum afrolaevigatum Dix.) 1
100 O. CAPENSE SCHELPE & FANSHAWE
200 O. TETRACONUM SCHELPE & FANSHAWE
300 O. WAGERI (BRDTH.) C.L. SMITH
(=Psilopilum wageri Broth.) 1

1926 -POLYTRICHASTRUM G.L. SMITH
1. FANSHAWE. 1980. POLYTRICHACEAE. M.SC. UCT.
100 P. FORMOSUM (HEDW.) G.L. SMITH
(=Polytrichum formosum Hedw.) 1

PTERIOOPHYTA Contributed by C. Reid

ADIANTACEAE 280

350 -DORYOPTERIS J. SM.
1. SCHELPE & ANTHONY. 1986. FSA.
2. JACOBSEN & JACOBSEN. 1988. BOTHALIA 18: 90.
200 D. PILOSA (POIR.) KUHN

370 -PITYROCRAMMA LINK
300 P. CALOMELANOS (SWARTZ) LINK VAR. AUREOFLAVA (HOOK.) WEATH. EX BAILEY *
(Note author change)

ASPIDIACEAE 590

605 -CYRTOMIUM PRESL
2. SCHELPE & ANTHONY. 1986. FSA.

BLECHNACEAE 690

690 -BLECHNUM L.
200 B. AUSTRALE L. VAR. AUSTRALE
(Correction of species number)

ANGIOSPERMAE

MONOCOTYLEDONAE Contributed by C. Reid and L. Fish

POACEAE Contributed by L. Fish 9900010

9900890 -DIGITARIA HALLER Revision: P.D.F. Kok (PRU).
3360 D. RUKWAE CLAYTON
(East tropical African species collected in Natal. 2732 (Ubombo): Lake St. Lucia, northern end of False Bay (-CD) Ellis 4517)
4970 D. VIOLASCENS LINK *
(Tropical Asian and American species collected in Natal. 2930 (Pietermaritzburg): Pietermaritzburg, Chase Valley (-CB) Ellis 4416)

9901020 -ERIOCHLOA KUNTH
95 E. MEYERIANA (NEES) PILG. SUBSP. GRANDIGLUMIS (STENT & RATTRAY) GIBBS RUSSELL
(Correction of species number and spelling)

9901070 -PASPALUM L.
4. BRUMMITT. 1983. TAXON. 32: 281.
150 P. DISTICHUM L.
(=P. paspalodes (Michx.) Scribn.) 4
P. paspalodes (Michx.) Scribn. = P. DISTICHUM

9901160 -PANICUM L.
800 P. COLORATUM L. VAR. COLORATUM
(=P. coloratum L. var. makarikariense Goossens) 3
P. coloratum L. var. makarikariense Goossens = P. COLORATUM VAR. COLORATUM

9901240 -SACCIOLEPIS NASH
300 S. CHEVALIERI STAPF
(Tropical African species. Specimens of this species have been misidentified under S. typhura)
500 S. cymbiandra auct., non Stapf = S. INTERRUPTA
730 S. INTERRUPTA (WILLD.) STAPF
(=S. cymbiandra auct., non Stapf)
(Indian to S.E. Asian species apparently introduced into Africa, previously wrongly identified as a West African species)

9901800 -PRIONANTHIUM DESV.
2. DAVIDSE. 1988. BOTHALIA 18,2: 149.
50 P. DENTATUM (L. F.) HENR.
(=P. rigidum Desv.) 2
P. rigidum Desv. = P. DENTATUM

9902860 -ERAGROSTIS WOLF
300 E. ANNULATA RENDLE EX SCOTT ELLIOT
(Note author correction for species)

ZAMIACEAE Contributed by C. Reid 3000

0005000 -ENCEPHALARTOS LEHM.
2. LAVRANOS & GOODE. 1988. BULL. JARD. BOT. NAT. BELG. 58: 219.
3. ROBBERTSE ET AL. 1988. S. AFR. J. BOT. 54,4: 363.
4. ROBBERTSE ET AL. 1988. S. AFR. J. BOT. 54,5: 487.
#. PRE HERBARIUM PRACTICE, FOLLOWING REID.
540 E. DOLOMITICUS LAVRANOS & GOODE
(=E.verrucosus P.J. Vorster et al.) #
560 E. DYERIANUS LAVRANOS & GOODE
(=E. graniticolus P.J. Vorster et al.) #
600 E. EUGENE-MARAISII VERDOORN SUBSP. EUGENE-MARAISII
650 E. EUGENE-MARAISII VERDOORN SUBSP. MIDDELBURGENSIS LAVRANOS & GOODE
E. graniticolus P.J. Vorster et al. = E. DYERIANUS
E. verrucosus P.J. Vorster et al. = E. DOLOMITICUS

PINACEAE Contributed by C. Reid 22000

0022000 -PINUS L.
250 P. PINEA L. *
(Exotic species becoming naturalised. 3226 (Port Beaufort) (-AD), on the road from Port Beaufort to Tarkastad near Penella Falls Farm, Henderson 962)

HYDROCHARITACEAE Contributed by C. Reid 85000

0087010 -EGERIA PLANCH.
(Note correction of genus number)

CYPERACEAE Contributed by C. Reid 452000

0459030 -MARISCUS GAERTN. Revision: P.J. Vorster (STE).
M. paradoxus (Cherm.) Cherm. = ALINULA PARADOXA

0459050 -ALINULA J. RAYNAL
1. GOETGHEBEUR & VORSTER. 1988. BULL. JARD. BOT. NAT. BELG. 58: 457.
100 A. PARADOXA (CHERM.) GOETGHEBEUR & VORSTER
(=Mariscus paradoxus (Cherm.) Cherm.) 1

0471000 -FIMBRISTYLIS VAHL
F. exilis (H.B.K.) Roem. & Schult. = BULBOSTYLIS HISPIDULA

0471010 -BULBOSTYLIS KUNTH
4. GOETGHEBEUR & COUDIJZER. 1985. BULL. JARD. BOT. NAT. BELG. 55: 207.
770 B. HISPIDULA (VAHL) R. HAINES
(=Fimbristylis exilis (H.B.K.) Roem. & Schult.) 4

0525000 -CAREX L. Revision: C. Reid (PRE).
2. CLARKE. 1908. KEW BULL. ADD. SER. 8: 74.
C. condensata C.B. Cl. non Nees = C. ZULUENSIS
2300 C. ZULUENSIS C.B. CL.
(=C. condensata C.B. Cl. non Nees) 2

ARACEAE Contributed by C. Reid 684000

0764000 -STYLOCHITON LEPR.
#. PRE HERBARIUM PRACTICE, FOLLOWING MAYO (KEW).
100 S. NATALENSIS SCHOTT
(=S. obliquinervis Peter) #
(=S. puberulus N.E. Br.) #
(=S. rogersii N.E. Br.) #
S. obliquinervis Peter = S. NATALENSIS
S. puberulus N.E. Br. = S. NATALENSIS
S. rogersii N.E. Br. = S. NATALENSIS

RESTIONACEAE Contributed by C. Reid 804000

0804140 -CANNOMOIS DESV. (Previous number 0817000)
500 C. SCIRPOIDES (KUNTH) MAST.
(Note author correction)

JUNCACEAE Contributed by C. Reid 930000

0936000 -JUNCUS L.
720 J. CAPENSIS THUNB. X J. LOMATOPHYLLUS SPRENG.

LILIACEAE Contributed by C. Reid 942000

0969000 -ANDROCYMBIUM WILLD. Revision: U. & D. Muller-Doblies (Herb. M-D).
1870 A. POELTIANUM U. & D. MULLER-DOBLIES
(Note change in species number)

1012000 -ERIOSPERMUM JACQ. EX WILLD.
#. PRE HERBARIUM PRACTICE, FOLLOWING PERRY.
2280 E. DIELSIANUM SCHLTR. EX V. POELLN.
3370 E. LANUGINOSUM JACQ.

1027000 -GASTERIA DUVAL Revision: E. van Jaarsveld (NBC).
##. PRE HERBARIUM PRACTICE, FOLLOWING VAN JAARSVELD.
2100 G. EXCELSA BAK.
4150 G. OBLIQUA (DC.) DUVAL

1081000 -GALTONIA DECNE.
3. HILLIARD & BURTT. 1988. NOTES R. BOT. GDN EDINB. 45: 95.
200 G. PRINCEPS (BAK.) DECNE.

1098000 -LACHENALIA JACQ. F. EX MURRAY
11. DUNCAN. 1988. ANN. KIRSTENB. BOT. GARD. 17.
200 L. ALOIDES (L. F.) ENGL. VAR. ALOIDES
(Note author change)
210 L. ALOIDES (L. F.) ENGL. VAR. AUREA (LINDL.) ENGL.
215 L. ALOIDES (L. F.) ENGL. VAR. QUADRICOLOR (JACQ.) ENGL.
220 L. ALOIDES (L. F.) ENGL. VAR. VANZYLIAE W.F. BARKER
(Note author change)
700 L. BULBIFERA (CYR.) ENGL.
(Note author change)

1109000 -DRACAENA VAND. EX L.
##. PRE HERBARIUM PRACTICE, FOLLOWING BOS.
150 D. MANNII BAK.

1113000 -ASPARAGUS L. Revision: A.A. Obermeyer (PRE).
A. asparagoides sensu Jessop, non (L.) Wight, p.p. = MYRSIPHYLLUM ASPARAGOIDES
A. asparagoides sensu Jessop, non (L.) Wight, p.p. = MYRSIPHYLLUM KRAUSSIANUM
A. asparagoides sensu Jessop, non (L.) Wight, p.p. = MYRSIPHYLLUM MULTITUBEROSUM
A. asparagoides sensu Jessop, non (L.) Wight, p.p. = MYRSIPHYLLUM OVATUM
A. asparagoides sensu Jessop, non (L.) Wight, p.p. = MYRSIPHYLLUM VOLUBILE

1113020 -MYRSIPHYLLUM WILLD.
1. OBERMEYER. BOTHALIA 15: 77.
200 M. ASPARAGOIDES (L.) WILLD.
(=Asparagus asparagoides sensu Jessop, non (L.) Wight, p.p.) 1
600 M. KRAUSSIANUM KUNTH
(=Asparagus asparagoides sensu Jessop, non (L.) Wight, p.p.) 1
700 M. MULTITUBEROSUM (R.A. DYER) OBERM.
(=Asparagus asparagoides sensu Jessop, non (L.) Wight, p.p.) 1
800 M. OVATUM (SALTER) OBERM.

(=Asparagus asparagoides sensu Jessop, non (L.) Wight, p.p.) 1
1200 M. VOLUBILE (THUNB.) OBERM.
(=Asparagus asparagoides sensu Jessop, non (L.) Wight, p.p.) 1

HYPOXIDACEAE Contributed by C. Reid 1229010

1230000 -HYPOXIS L.
270 H. ANGUSTIFOLIA LAM. VAR. BUCHANANII BAK. X H. MEMBRANACEA BAK.

DIOSCOREACEAE Contributed by C. Reid 1250000

1252000 -DIOSCOREA L.
1400 D. MUNDII BAK.
(Note spelling change)

IRIDACEAE Contributed by C. Reid 1259000

1265000 -MORAEA MILL.
1. GOLDBLATT. 1973. ANN. MISSOURI BOT. GARD. 60: 204.
9. GOLDBLATT. 1986. ANN. KIRSTENBOSCH BOT. GARD. 14.
1520 M. BREVISTYLA (GOLDBL.) GOLDBL.
(=M. pubiflora N.E. Br. subsp. brevistyla Goldbl.) 9
2370 M. EXILIFLORA GOLDBL.
3350 M. GARIPENSIS GOLDBL.
M. mossii N.E. Br. = M. STRICTA
5320 M. NAMAQUAMONTANA GOLDBL.
M. pubiflora N.E. Br. subsp. brevistyla Goldbl. = M. BREVISTYLA
7300 M. STRICTA BAK.
(=M. mossii N.E. Br.) 1, 9
(=M. thomsonii sensu Goldbl. 1977, p.p., non Bak.) 9
(=M. trita N.E. Br.) 1, 9
7455 M. THOMSONII BAK.
M. thomsonii sensu Goldbl. 1977, p.p., non Bak. = M. STRICTA
M. trita N.E. Br. = M. STRICTA
8240 M. VERECUNDA GOLDBL.

1273000 -HEXAGLOTTIS VENT.
3. GOLDBLATT. 1987. ANN. MISSOURI BOT. GARD. 74: 542.
50 H. BREVITUBA GOLDBL.
H. flexuosa (L. f.) Sweet = H. LEWISIAE SUBSP. LEWISIAE
100 H. LEWISIAE GOLDBL. SUBSP. LEWISIAE
(=H. flexuosa (L. f.) Sweet) 2
120 H. LEWISIAE GOLDBL. SUBSP. SECUNDA GOLDBL.
200 H. LONGIFOLIA (JACQ.) SALISB.
(=H. longifolia (Jacq.) Vent. var. angustifolia G.J. Lewis) 3
H. longifolia (Jacq.) Vent. var. angustifolia C.J. Lewis = H. LONGIFOLIA
250 H. NAMAQUANA GOLDBL.
310 H. RIPARIA GOLDBL.
320 H. VIRGATA (JACQ.) SWEET SUBSP. KAROOICA GOLDBL.
400 H. VIRGATA (JACQ.) SWEET SUBSP. VIRGATA
(=H. virgata (Jacq.) Sweet var. lata G.J. Lewis) 3
H. virgata (Jacq.) Sweet var. lata G.J. Lewis = H. VIRGATA SUBSP. VIRGATA

1301000 -HESPERANTHA KER-GAWL. Revision: O.M. Hilliard & B.L. Burtt (E).
##. PRE HERBARIUM PRACTICE, FOLLOWING HILLIARD & BURTT.
2650 H. PUBINERVIA HILLIARD & BURTT
(Note spelling change)
2830 H. RUPESTRIS N.E. BR. EX R.C. FOST.

1302000 -IXIA L.
4. DE VOS. 1988. S. AFR. J. BOT. 54: 596.
1270 I. ESTERHUYSENIAE DE VOS
1450 I. FREDERICKII DE VOS
3320 I. MOSTERTII DE VOS

1303000 -DIERAMA K. KOCH Revision: O.M. Hilliard (E).
2. HILLIARD. 1988. NOTES R. BOT. GDN EDINB. 45: 78.
20 D. ADELPHICUM HILLIARD
50 D. AMBIGUUM HILLIARD
D. davyi N.E. Br. = D. INSIGNE
450 D. DISSIMILE HILLIARD
470 D. DRACOMONTANUM HILLIARD
620 D. ERECTUM HILLIARD
650 D. FLORIFERUM HILLIARD
670 D. FORMOSUM HILLIARD
1000 D. INSIGNE N.E. BR.
(=D. davyi N.E. Br.) 2
1050 D. JUCUNDUM HILLIARD
1400 D. MEDIUM N.E. BR.
D. medium N.E. Br. var. mossii N.E. Br. = D. MOSSII
1520 D. MOBILE HILLIARD
1540 D. MOSSII (N.E. BR.) HILLIARD
(=D. medium N.E. Br. var. mossii N.E. Br.) 2
1560 D. NEBROWNII HILLIARD
2650 D. TYRIUM HILLIARD

1306000 -TRITONIA KER-GAWL.
T. flava sensu Bak. non (Ait.) Ker-Gawl. = T. KAROOICA
1370 T. KAROOICA DE VOS
(=T. flava sensu Bak. non (Ait.) Ker-Gawl.) 1
T. mathewsiana L. Bol. = CROCOSMIA MATHEWSIANA

1306010 -CROCOSMIA PLANCH. Revision: M.P. de Vos (STEU).
3. DE VOS. 1984. JL S. AFR. BOT. 50: 463.
170 C. X CROCOSMIIFLORA (LEMOINE EX BURBIDGE & DEAN) N.E. BR.
(Note change in taxon number)
500 C. MATHEWSIANA (L. BOL.) GOLDBL. EX DE VOS
(=Tritonia mathewsiana L. Bol.) 3

1311000 -GLADIOLUS L.
5. HILLIARD & BURTT. 1983. NOTES R. BOT. GDN EDINB. 41: 306.
G. cruentus sensu Oberm., p.p., non S. Moore = G. FLANAGANII
4850 G. FLANAGANII BAK.
(=G. cruentus sensu Oberm., p.p., non S. Moore) 5

1312010 -TRITONIOPSIS L. BOL.
1. LEWIS. 1959. JL S. AFR. BOT. 25: 319.
400 T. DODII (G.J. LEWIS) G.J. LEWIS
(=Hebea dodii G.J. Lewis) 1

1312011 -Hebea L. Bol. non (Pers.) Hedw. f. = TRITONIOPSIS
H. dodii G.J. Lewis = TRITONIOPSIS DODII

1315000 -WATSONIA MILL. Revision: P. Goldblatt (MO).
5. GOLDBLATT. 1987. ANN. MISSOURI BOT. GARD. 74: 570.
#. PRE HERBARIUM PRACTICE, FOLLOWING GOLDBLATT.
450 W. BORBONICA (POURR.) GOLDBL.
(=W. pyramidata (Andr.) Stapf) 5
2320 W. LEPIDA N.E. BR.
W. pyramidata (Andr.) Stapf = W. BORBONICA

ORCHIDACEAE Contributed by C. Reid 1389000

1434000 -DISA BERG.
1. LINDER. 1981. CONTR. BOL. HERB. 9.
9. LINDER. 1988. S. AFR. J. BOT. 54: 496.
620 D. CEDARBERGENSIS LINDER
3750 D. OBTUSA LINDL. SUBSP. PICTA (SOND.) LINDER
(=D. picta Sond.) 1
D. picta Sond. = D. OBTUSA SUBSP. PICTA

1438000 -PTERYGODIUM SWARTZ
2. LINDER. 1988. S. AFR. J. BOT. 54: 496.
P. rubiginosum Sond. ex H. Bol. = CORYCIUM RUBIGINOSUM
1350 P. SCHELPEI LINDER

1439000 -CERATANDRA ECKL. EX BAUER
350 C. GRANDIFLORA LINDL. X C. ATRATA DUR. & SCHINZ

1440000 -CORYCIUM SWARTZ
1. ROLFE. 1913. FC 5: 283.
2. STEWART ET AL. 1982. WILD ORCH. S. AFR.
3. OLIVER. 1985. S. AFR. J. BOT. 52: 256.
#. PRE HERBARIUM PRACTICE, FOLLOWING SCHELPE.
1100 C. RUBIGINOSUM (SOND.) ROLFE
(=Pterygodium rubiginosum Sond. ex H. Bol.) 1, #

1561000 -ACROLOPHIA PFITZER
3. SUMMERHAYES & HALL. 1962. TAXON 11: 201.
4. LINDER. 1988. S. AFR. J. BOT. 54: 496.
#. PRE HERBARIUM PRACTICE, FOLLOWING HALL.
##. PRE HERBARIUM PRACTICE, FOLLOWING LINDER.
20 A. BARBATA (THUNB.) LINDER
(=A. lunata (Schltr.) Schltr. & H. Bol.) 4
150 A. CAPENSIS (BERG.) FOURC.
A. capensis (Berg.) Fourc. var. lamellata (Lindl.) Schelpe = A. LAMELLATA
A. comosa (Sond.) Schltr. & H. Bol. = A. CAPENSIS
400 A. LAMELLATA (LINDL.) SCHLTR. & H. BOL.
(=A. capensis (Berg.) Fourc. var. lamellata (Lindl.) Schelpe) ##
(=Eulophia barbata (Thunb.) Spreng.) 3, #
A. lunata (Schltr.) Schltr. & H. Bol. = A. BARBATA
650 A. PANICULATA CRIBB
A. sphaerocarpa (Sond.) Schltr. & H. Bol. = A. CAPENSIS
A. triatis (L. f.) Schltr. & H. Bol. = A. CAPENSIS

1565000 -POLYSTACHYA HOOK.
#. PRE HERBARIUM PRACTICE, FOLLOWING LINDER.
300 P. MODESTA REICHB. F.
800 P. TESSELLATA LINDL.

1568000 -ANSELLIA LINDL.
#. PRE HERBARIUM PRACTICE, FOLLOWING LINDER.
20 A. AFRICANA LINDL.
(=A. africana Lindl. var. australis Summerh.) #
(=A. gigantea Reichb. f. var. gigantea) #
(=A. gigantea Reichb. f. var. nilotica (Bak.) Summerh.) #
A. africana Lindl. var. australis Summerh. = A. AFRICANA
A. gigantea Reichb. f. var. gigantea = A. AFRICANA
A. gigantea Reichb. f. var. nilotica (Bak.) Summerh. = A. AFRICANA

1648000 -EULOPHIA R. BR. EX LINDL.
E. barbata (Thunb.) Spreng. = AGROLOPHIA LAMELLATA

SALICACEAE Contributed by B.J. Pienaar 1872000

1873000 -SALIX L.
#. PRE HERBARIUM PRACTICE, FOLLOWING IMMELMAN.
S. capensis Thunb. var. gariepina (Burch.) Anders. = S. MUCRONATA SUBSP. CAPENSIS
570 S. MUCRONATA THUNB. SUBSP. CAPENSIS (THUNB.) IMMELMAN
(=S. capensis Thunb. var. gariepina (Burch.) Anders.) #
(=S. mucronata Thunb. var. caffra Burtt Davy) #
(=S. mucronata Thunb. var. integra Burtt Davy) #
700 S. MUCRONATA THUNB. SUBSP. WILMSII (SEEMEN) IMMELMAN
(=S. woodii Seemen var. wilmsii (Seemen) Skan) #
S. mucronata Thunb. var. caffra Burtt Davy = S. MUCRONATA SUBSP. CAPENSIS
S. mucronata Thunb. var. integra Burtt Davy = S. MUCRONATA SUBSP. CAPENSIS
S. woodii Seemen var. wilmsii (Seemen) Skan = S. MUCRONATA SUBSP. WILMSII

MORACEAE Contributed by B.J. Pienaar 1908000

1961000 -FICUS L. Revision: C.C. Berg (U); H. Baijnath (UD-W); J.V. van Greuning (PRU).
3. BERG ET AL. 1984. FL. DU GABON 148.
4. BERG. 1986. BULL. MUS. NATN. HIST. NAT. PARIS 4: 39-40.
5. BERG. 1988. KEW BULL. 43,1: 77-97.
#. PRE HERBARIUM PRACTICE, FOLLOWING PIENAAR.
50 F. ABUTILIFOLIA MIQ.
(=F. soldanella Warb.) 3
F. burkei (Miq.) Miq. = F. THONNINGII
F. capensis Thunb. = F. SUR
700 F. CORDATA THUNB. SUBSP. CORDATA
750 F. CORDATA THUNB. SUBSP. SALICIFOLIA (VAHL) BERG.
(=F. salicifolia Vahl) 5
F. exasperata Vahl = F. SYCOMORUS
900 F. FISCHERI WARB. EX MILDBR. & BURR.
(=F. kiloneura Hornby) 5
1000 F. GLUMOSA DEL.
(=F. sonderi Miq.) 5
1200 F. INGENS (MIQ.) MIQ. VAR. INGENS
(=F. ingens Miq. var. tomentosa Hutch.) 3
F. ingens Miq. var. tomentosa Hutch. = F. INGENS VAR. INGENS
F. kiloneura Hornby = F. FISCHERI
1300 F. LUTEA VAHL
(=F. nekbudu Warb.) 3
(=F. quebeba Welw. ex Fical.) 4
(=F. vogelii (Miq.) Miq.) 5
1500 F. NATALENSIS HOCHST. SUBSP. NATALENSIS
F. nekbudu Warb. = F. LUTEA
F. petersii Warb. = F. THONNINGII
1600 F. POLITA VAHL SUBSP. POLITA
F. pretoriae Burtt Davy = F. CORDATA SUBSP. SALICIFOLIA
F. quebeba Welw. ex Fical. = F. LUTEA
F. salicifolia Vahl = F. CORDATA SUBSP. SALICIFOLIA
F. soldanella Warb. = F. ABUTILIFOLIA
F. sonderi Miq. = F. GLUMOSA
2250 F. SUR FORSSK.
(=F. capensis Thunb.) 5
2300 F. SYCOMORUS L.
(=F. exasperata Vahl) #
2450 F. THONNINGII BLUME
(=F. burkei (Miq.) Miq.) 5
(=F. petersii Warb.) 5
F. vogelii (Miq.) Miq. = F. LUTEA

PROTEACEAE Contributed by B.J. Pienaar 2016000

2031000 -MIMETES SALISB.
2. ROURKE. 1988. JL. S. AFR. BOT. 54,6: 636-639.
250 M. CHRYSANTHUS ROURKE

2035000 -PROTEA L.
4. CHISUMPA & BRUMMITT. 1987. KEW BULL. 42,4: 815-853.
P. bolusii Phill. = P. CAFFRA SUBSP. CAFFRA
1200 P. CAFFRA MEISN. SUBSP. CAFFRA
(=P. bolusii Phill.) 3
(=P. multibracteata Phill.) 3
(=P. rhodantha Hook. f.) 3
P. multibracteata Phill. = P. CAFFRA SUBSP. CAFFRA
P. rhodantha Hook. f. = P. CAFFRA SUBSP. CAFFRA

OLACACEAE Contributed by B.J. Pienaar 2129000

2136000 -XIMENIA L.
150 X. AMERICANA L.
(=X. americana L. var. microphylla Welw. ex Oliv.) 1
(=X. rogersii Burtt Davy) 1
X. americana L. var. microphylla Welw. ex Oliv. = X. AMERICANA
X. rogersii Burtt Davy = X. AMERICANA

HYDNORACEAE Contributed by B.J. Pienaar 2182000

2182000 -HYDNORA THUNB.
3. MUSSELMAN & VISSER. 1987. DINTERIA 19: 77-82.
150 H. JOHANNIS BECCARI
(=H. solmsiana Dinter) 3
H. solmsiana Dinter = H. JOHANNIS

POLYGONACEAE Contributed by B.J. Pienaar 2184000

2204000 -OXYGONUM BURCH.
4. GERMISHUIZEN. 1988. BOTHALIA 18,2: 173-181, 187-188.
#. PRE HERBARIUM PRACTICE, FOLLOWING GERMISHUIZEN.
50 O. ACETOSELLA WELW.
O. calcaratum Meisn. = O. DREGEANUM SUBSP. CANESCENS VAR. CANESCENS
O. canescens Sond. = O. DREGEANUM SUBSP. CANESCENS VAR. CANESCENS
O. canescens Sond. var. subglabra Schinz = O. DREGEANUM SUBSP. CANESCENS VAR. CANESCENS
300 O. DELAGOENSE KUNTZE
(=O. delagoense Kuntze var. strictum C.H. Wr.) #
(=O. dregeanum Meisn. var. pubescens (C.H. Wr.) Burtt Davy) #
(=O. dregeanum Meisn. var. strictum (C.H. Wr.) R.A. Grah.) #
O. delagoense Kuntze var. strictum C.H. Wr. = O. DELAGOENSE
400 O. DREGEANUM MEISN. SUBSP. CANESCENS (SOND.) GERMISHUIZEN VAR. CANESCENS
(=O. calcaratum Meisn.) 1
(=O. canescens Sond.) 1
(=O. canescens Sond. var. subglabra Schinz) 1
(=O. dregeanum Meisn. var. canescens (Sond.) R.A. Grah.) 4
(=O. zeyheri Sond.) 1
430 O. DREGEANUM MEISN. SUBSP. CANESCENS (SOND.) GERMISHUIZEN VAR. DISSECTUM GERMISHUIZEN
450 O. DREGEANUM MEISN. SUBSP. CANESCENS (SOND.) GERMISHUIZEN VAR. LINEARIFOLIUM GERMISHUIZEN
470 O. DREGEANUM MEISN. SUBSP. CANESCENS (SOND.) GERMISHUIZEN VAR. LOBOPHYLLUM GERMISHUIZEN
490 O. DREGEANUM MEISN. SUBSP. CANESCENS (SOND.) GERMISHUIZEN VAR. PILOSUM GERMISHUIZEN
500 O. DREGEANUM MEISN. SUBSP. DREGEANUM
(=O. dregeanum Meisn. var. dregeanum) 4
(=O. dregei Meisn.) 1
(=O. natalense Schlechter) 1
550 O. DREGEANUM MEISN. SUBSP. LANCEOLATUM GERMISHUIZEN
750 O. DREGEANUM MEISN. SUBSP. STREYI GERMISHUIZEN
800 O. DREGEANUM MEISN. SUBSP. SWAZICUM (BURTT DAVY) GERMISHUIZEN
(=O. dregeanum Meisn. var. swazicum (Burtt Davy) R.A. Grah.) 4
(=O. zeyheri Sond. var. swazicum Burtt Davy) 4
O. dregeanum Meisn. var. canescens (Sond.) R.A. Grah. = O. DREGEANUM SUBSP. CANESCENS VAR. CANESCENS
O. dregeanum Meisn. var. dregeanum = O. DREGEANUM SUBSP. DREGEANUM
O. dregeanum Meisn. var. pubescens (C.H. Wr.) Burtt Davy = O. DELAGOENSE
O. dregeanum Meisn. var. strictum (C.H. Wr.) R.A. Grah = O. DELAGOENSE
O. dregeanum Meisn. var. swazicum (Burtt Davy) R.A. Grah. = O. DREGEANUM SUBSP. SWAZICUM
O. dregei Meisn. = O. DREGEANUM SUBSP. DREGEANUM
O. natalense Schlechter = O. DREGEANUM SUBSP. DREGEANUM
O. zeyheri Sond. = O. DREGEANUM SUBSP. CANESCENS VAR. CANESCENS
O. zeyheri Sond. var. swazicum Burtt Davy = O. DREGEANUM SUBSP. SWAZICUM

CHENOPODIACEAE Contributed by B.J. Pienaar 2214000

2221000 -BETA L. *
1. TUTIN. 1964. FL. EUROP. 1: 91.
100 B. VULGARIS L. *

2229000 -ATRIPLEX L. Revision: M. Nobs (CI).
1. HALL & CLEMENTS. 1923. PHYLOGENETIC METHODS IN TAXONOMY 247-248.
1450 A. VESICARIA HEWARD EX BENTH. SUBSP. APPENDICULATA (BENTH.) PARR-SMITH

2269000 -SALSOLA L.
3. BOTSCH. 1978. BOT. ZHOURNAL 63,6: 832-836.
4. BOTSCH. 1981. BOT. ZHOURNAL 66,7: 1036-1040.
5. BOTSCH. 1983. BOT. ZHOURNAL 68,9: 1247-1249.
1950 S. CAULIFLORA BOTSCH.
2650 S. DENUDATA BOTSCH.
3125 S. GARUBICA BOTSCH.

3350 S. CEMMIPARA BOTSCH.
3725 S. HOANIBICA BOTSCH.
3750 S. HOTTENTOTICA BOTSCH.
3775 S. HUABICA BOTSCH.
4155 S. KLEINFONTEINI BOTSCH.
4350 S. MARCINATA BOTSCH.
4750 S. MIRABILIS BOTSCH.
5050 S. OKAUKUEJENSIS BOTSCH.
5075 S. OMARURUENSIS BOTSCH.
5550 S. PROCERA BOTSCH.
5575 S. PTILOPTERA BOTSCH.
5650 S. ROBINSONII BOTSCH.
6350 S. SPENCERI BOTSCH.
6450 S. SWAKOPMUNDI BOTSCH.
6750 S. UGABICA BOTSCH.
6755 S. UNJABICA BOTSCH.

AMARANTHACEAE Contributed by B.J. Pienaar 2289000

AIZOACEAE Contributed by B.J. Pienaar 2374000

2376000 -LIMEUM L.
1475 L. INDICUM STOCKS EX ANDERSON

MESEMBRYANTHEMACEAE Contrib. by B.J. Pienaar 2405001

2405011 -ARGYRODERMA N.E. BR.
2. HARTMANN. 1977. MITT. INST. ALLG. BOT. HAMBURC 15: 121-235.
A. amoenum Schwant. = A. PEARSONII
A. angustipetalum L. Bol. = A. CONGREGATUM
A. aureum L. Bol. = A. DELAETII
A. australe L. Bol. = A. DELAETII
A. blandum L. Bol. = A. DELAETII
A. boreale L. Bol. = A. DELAETII
A. braunsii (Schwant.) Schwant. = A. FISSUM
A. brevipes (Schltr.) L. Bol. = A. FISSUM
A. brevitubum L. Bol. = A. DELAETII
A. carinatum L. Bol. p.p. = A. DELAETII
A. carinatum L. Bol. p.p. = A. TESTICULARE
A. citrinum L. Bol. = A. DELAETII
A. concinnum Schwant. = A. DELAETII
100 A. CONCREGATUM L. BOL.
(=A. angustipetalum L. Bol.) 2
(=A. jacobaenianum Schwant.) 2
(=A. nortieri L. Bol.) 2
(=A. peersii L. Bol.) 2
(=A. rooipanense L. Bol. p.p.) 2
200 A. CRATERIFORME (L. BOL.) N.E. BR.
(=A. pulvinare L. Bol.) 2
(=A. subrotundum L. Bol.) 2
A. cuneatipetalum L. Bol. p.p. = A. DELAETII
A. cuneatipetalum L. Bol. p.p. = A. PEARSONII
300 A. DELAETII MAASS
(=A. aureum L. Bol.) 2
(=A. australe L. Bol.) 2
(=A. blandum L. Bol.) 2
(=A. boreale L. Bol.) 2
(=A. brevitubum L. Bol.) 2
(=A. carinatum L. Bol. p.p.) 2
(=A. citrinum L. Bol.) 2
(=A. concinnum Schwant.) 2
(=A. cuneatipetalum L. Bol. p.p.) 2
(=A. densipetalum L. Bol.) 2
(=A. formosum L. Bol.) 2
(=A. gregarium L. Bol.) 2
(=A. latifolium L. Bol.) 2
(=A. lesliei R. Br.) 2
(=A. leucanthum L. Bol.) 2
(=A. longipes L. Bol.) 2
(=A. productum L. Bol.) 2
(=A. reniforme L. Bol.) 2
(=A. rooipanense L. Bol. p.p.) 2
(=A. roseum Schwant. forma delaetii Rowl.) 2
(=A. roseum Schwant. forma roseum) 2
(=A. schuldtii Schwant.) 2
(=A. speciosum L. Bol.) 2
(=A. splendens L. Bol.) 2
A. densipetalum L. Bol. = A. DELAETII
A. digitifolium (N.E. Br.) Schwant. = A. FISSUM
400 A. FISSUM (HAW.) L. BOL.
(=A. braunsii (Schwant.) Schwant.) 2
(=A. brevipes (Schltr.) L. Bol.) 2
(=A. digitifolium (N.E. Br.) Schwant.) 2
(=A. hutchinsonii L. Bol.) 2
(=A. latipetalum L. Bol. var. latipetalum) 2
(=A. latipetalum L. Bol. var. longitubum L. Bol.) 2
(=A. litorale L. Bol.) 2
(=A. orientale L. Bol.) 2
A. formosum L. Bol. = A. DELAETII
A. framesii L. Bol. 1929 nec 1934 = A. PEARSONII
500 A. FRAMESII L. BOL. SUBSP. FRAMESII
(=A. framesii L. Bol. var. framesii) 2
(=A. framesii L. Bol. var. minus L. Bol.) 2
A. framesii L. Bol. var. framesii = A. FRAMESII SUBSP. FRAMESII
A. framesii L. Bol. var. minus L. Bol. = A. FRAMESII SUBSP. FRAMESII
A. gregarium L. Bol. = A. DELAETII
A. hutchinsonii L. Bol. = A. FISSUM
A. jacobaenianum Schwant. = A. CONGREGATUM
A. latifolium L. Bol. = A. DELAETII
A. latipetalum L. Bol. var. latipetalum = A. FISSUM
A. latipetalum L. Bol. var. longitubum L. Bol. = A. FISSUM
A. lesliei R. Br. = A. DELAETII
A. leucanthum L. Bol. = A. DELAETII
A. litorale L. Bol. = A. FISSUM
A. longipes L. Bol. = A. DELAETII
A. luckoffii L. Bol. = A. PEARSONII
A. nortieri L. Bol. = A. CONCREGATUM
A. orientale L. Bol. = A. FISSUM
A. ovale L. Bol. = A. PEARSONII
800 A. PEARSONII (N.E. BR.) SCHWANT.
(=A. amoenum Schwant.) 2
(=A. cuneatipetalum L. Bol. p.p.) 2
(=A. framesii L. Bol. 1929 nec 1934) 2
(=A. luckoffii L. Bol.) 2
(=A. ovale L. Bol.) 2
(=A. schlechteri Schwant.) 2
A. peersii L. Bol. = A. CONGREGATUM
A. productum L. Bol. = A. DELAETII
A. pulvinare L. Bol. = A. CRATERIFORME
A. reniforme L. Bol. = A. DELAETII
A. rooipanense L. Bol. p.p. = A. CONCREGATUM
A. rooipanense L. Bol. p.p. = A. DELAETII
A. roseum Schwant. forma delaetii Rowl. = A. DELAETII
A. roseum Schwant. forma roseum = A. DELAETII
A. schlechteri Schwant. = A. PEARSONII
A. schuldtii Schwant. = A. DELAETII
A. speciosum L. Bol. = A. DELAETII
A. splendens L. Bol. = A. DELAETII
1000 A. SUBALBUM (N.E. BR.) N.E. BR.
(=A. villetii L. Bol.) 2
A. subrotundum L. Bol. = A. CRATERIFORME
1100 A. TESTICULARE (AIT.) N.E. BR.
(=A. carinatum L. Bol. p.p.) 2
A. villetii L. Bol. = A. SUBALBUM

2405030 -CONOPHYTUM N.E. BR.
8. HAMMER. 1988. ALOE 25,2: 34-35.
4250 C. BUYSIANUM A.R. MITCHELL & HAMMER
4300 C. CALCULUS (BERCER) N.E. BR. VAR. CALCULUS
4350 C. CALCULUS (BERCER) N.E. BR. VAR. KOMKANSICUM (L. BOL.) RAWE
4400 C. CALCULUS (BERCER) N.E. BR. VAR. PROTUSUM L. BOL.

2405071 -MALEPHORA N.E. BR.
1060 M. PURPUREO-CROCEA (HAW.) JACOBSEN & SCHWANT.

2405073 -MESEMBRYANTHEMUM L.
4455 M. SCHWANTESIA (L.) GLEN

2405158 -ROODIA N.E. BR.
1. N.E. BROWN. 1922. FSA 2: 78.

2405160 -TANQUANA H.E.K. HARTM. & LIEDE
2. HARTMANN & LIEDE. 1986. BOT. JB. 106: 433-485.
100 T. ARCHERI (L. BOL.) H.E.K. HARTM. & LIEDE
200 T. HILMARII (L. BOL.) H.E.K. HARTM. & LIEDE
300 T. PRISMATICA (MARLOTH) H.E.K. HARTM. & LIEDE

CARYOPHYLLACEAE (PART A) Contrib. by B.J. Pienaar 2429000

2430000 -CERASTIUM L.
2. JALAS. 1964. FL. EUROP. 1: 142.
#. PRE HERBARIUM PRACTICE, FOLLOWINC MOSCHL.
C. caespitosum Cilib. subsp. triviale (Link) Hiitonen = C. FONTANUM SUBSP. TRIVIALE
275 C. FONTANUM BAUMG. SUBSP. TRIVIALE (LINK) JALAS
(=C. caespitosum Cilib. subsp. triviale (Link) Hiitonen) 2
(=C. holosteoides Fr.) 2
(=C. holosteoides Fr. subsp. triviale (Murb.) Moschl) #
(=C. triviale Link) 2
(=C. vulgatum L.) 2
C. holosteoides Fr. = C. FONTANUM SUBSP. TRIVIALE
C. holosteoides Fr.. subsp. triviale (Murb.) Moschl = C. FONTANUM SUBSP. TRIVIALE
C. triviale Link = C. FONTANUM SUBSP. TRIVIALE
C. vulgatum L. = C. FONTANUM SUBSP. TRIVIALE

ILLECEBRACEAE Contributed by B.J. Pienaar 2467000

2476000 -HERNIARIA L.
200 H. ERCKERTII HERMANN SUBSP. ERCKERTII VAR. DEWETII HERMANN
300 H. ERCKERTII HERMANN SUBSP. ERCKERTII VAR. DINTERI CHAUDRI
400 H. ERCKERTII HERMANN SUBSP. ERCKERTII VAR. ERCKERTII
500 H. ERCKERTII HERMANN SUBSP. PULVINATA CHAUDHRI
600 H. CRIMMII HERMANN
700 H. SCHLECHTERI HERMANN

LAURACEAE Contributed by B.J. Pienaar 2782000

2801000 -Beilschmiedia Nees = DAHLCRENODENDRON
B. natalensis J.H. Ross = DAHLGRENODENDRON NATALENSIS

2813010 -DAHLCRENODENDRON J.J.M. V.D. MERWE & VAN WYK
1. VAN DER MERWE, VAN WYK & KOK. 1988. JL S. AFR. BOT. 54,1: 80-87.
100 D. NATALENSIS (J.H. ROSS) J.J.M. V.D. MERWE & VAN WYK
(=Beilschmiedia Nees) 1

PAPAVERACEAE Contributed by B.J. Pienaar 2833000

2853000 -PAPAVER L.
1. MOWAT & WALTERS. FL. EUROP. 1: 248-249.
150 P. ARCEMONE L. *

BRASSICACEAE Contributed by B.J. Pienaar 2863000

2875000 -HELIOPHILA L.
4. PIENAAR & NICHOLAS. 1988. BOTHALIA 18,2: 183-188.
1950 H. CORNELLSBERGIA PIENAAR & NICHOLAS

CRASSULACEAE Contributed by B.J. Pienaar 3161000

3164000 -COTYLEDON L.
3237 C. ORBICULATA L. VAR. ORBICULATA
(=C. ramosissima Mill., non Haw.) 1
C. ramosissima Mill., non Haw. = C. ORBICULATA VAR. ORBICULATA

3164010 -TYLECODON TOELKEN
2. VAN JAARSVELD. 1988. ALOE 25,2: 30-32.
50 T. BAYERI VAN JAARSVELD

3175000 -ADROMISCHUS LEM.
950 A. CRISTATUS (HAW.) LEM. VAR. CLAVIFOLIUS (HAW.) TOELKEN
(=A. poellnitzianus Werderm.) 1
A. poellnitzianus Werderm. = A. CRISTATUS VAR. CLAVIFOLIUS

ROSACEAE Contributed by B.J. Pienaar 3316000

3375000 -ALCHEMILLA L.
450 A. GALPINII HAUM. & BALLE

FABACEAE Contributed by G. Germishuizen and B.D. Schrire 3436000

3443000 -ALBIZIA DURAZZ.
A. distachya (Vent.) MacBride = PARASERIANTHES LOPHANTHA SUBSP. LOPHANTHA
A. lophantha (Willd.) Benth. = PARASERIANTHES LOPHANTHA SUBSP. LOPHANTHA

3443010 -PARASERIANTHES NIELSEN
(Note change of spelling)
100 P. LOPHANTHA (WILLD.) NIELSEN SUBSP. LOPHANTHA *
(=Acacia lophantha Willd.) 1
(=Albizia distachya (Vent.) MacBride) 1
(=Albizia lophantha (Willd.) Benth.) 1
(=Mimosa distachya Vent.) 1

3446000 -ACACIA MILL.
A. lophantha Willd. = PARASERIANTHES LOPHANTHA SUBSP. LOPHANTHA

3449000 -MIMOSA L.
M. distachya Vent. = PARASERIANTHES LOPHANTHA SUBSP. LOPHANTHA

3653000 -Borbonia L. = ASPALATHUS
B. leiantha Phill. = ASPALATHUS CRENATA
B. pinifolia Marl. = ASPALATHUS LINEARIS SUBSP. PINIFOLIA

3657000 -LOTONONIS (DC.) ECKL. & ZEYH.
1. HARVEY. 1862. FC 2: 60.
8. VAN WYK. 1988. BOTHALIA 18,1: 31-36.
9. VAN WYK. 1988. S. AFR. J. BOT. 54,2: 175-181.
10. VAN WYK. 1988. S. AFR. J. BOT. 54,6: 628.
1650 L. CAERULESCENS (E. MEY.) B.-E. VAN WYK
(=Aspalathus caerulescens E. Mey.) 9
2150 L. COMPTONII B.-E. VAN WYK
2650 L. DAHLGRENII B.-E. VAN WYK
3250 L. DISSITINODIS B.-E. VAN WYK
5050 L. LENTICULA (E. MEY.) BENTH.
(=Crotalaria lenticula E. Mey.) 9
5130 L. LEUCOCLADA (SCHLTR.) DUEMMER
(=Lebeckia leucoclada Schltr.) 1
6150 L. MINIMA B.-E. VAN WYK
L. omahekensis Dinter ex A. Schreib. = INDIGOFERA ARENOPHILA
7350 L. PORRECTA (E. MEY.) BENTH.
8470 L. SABULOSA SALTER

3660000 -LEBECKIA THUNB. Revision: A. Schreiber (M).
L. contaminata Ait. f. non Willd. = INDIGOFERA FILIFOLIA
L. contaminata Ker-Gawl. non Thunb. = INDIGOFERA FILIFOLIA
L. leucoclada Schltr. = LOTONONIS LEUCOCLADA
L. nuda Sims = INDIGOFERA FILIFOLIA

3662000 -ASPALATHUS L.
16. DAHLGREN. 1988. FSA 16,3: 1-430.
A. acuminata Lam. subsp. magniflora Dahlg. = A. TULBAGHENSIS DAHLG.
A. adelphea Eckl. & Zeyh. = A. SUBTINGENS
A. AEMULA E. MEY.
(=A. sericea Berg. subsp. aemula (E. Mey.) Dahlg.) 16
(=Ononis spicata Thunb.) 1, 16
(=Paraspalathus aemula (E. Mey.) Presl) 1, 16
2050 A. AMOENA (DAHLG.) DAHLG.
(=A. retroflexa L. subsp. amoena Dahlg.) 10
A. argentea L. = A. CALEDONENSIS
A. benthamii Harv. = A. SPICATA
4250 A. BREVICARPA (DAHLG.) DAHLG.
(=A. divaricata Thunb. subsp. brevicarpa Dahlg.) 16
A. caerulescens E. Mey. = LOTONONIS CAERULESCENS
4700 A. CALEDONENSIS DAHLG.
(=A. argentea L.) 16
(=Paraspalathus argentea (L.) Presl) 1, 16
5000 A. CANDICANS AIT. F.
A. capitella Burch. ex Benth. = A. INOPS
5800 A. CHORTOPHILA ECKL. & ZEYH.
(=A. frankenioides DC. a. chortophila (Eckl. & Zeyh.) Harv.) 10
A. chortophila Eckl. & Zeyh. subsp. congesta Dahlg. = A. CONGESTA
A. chortophila Eckl. & Zeyh. subsp. kougaensis Dahlg. = A. KOUGAENSIS
6350 A. CLIFFORTIOIDES H. BOL.
(=A. spicata Thunb. subsp. cliffortioides (H. Bol. in Schltr.) Dahlg.) 16
7150 A. CONGESTA (DAHLG.) DAHLG.
(=A. chortophila Eckl. & Zeyh. subsp. congesta Dahlg.) 16
7250 A. CORDICARPA DAHLG.
7700 A. CRENATA (L.) DAHLG.
(=A. leiantha (Phill.) Dahlg.) 16
(=Borbonia leiantha Phill.) 6, 14, 16
7800 A. CUSPIDATA DAHLG.
A. cuspidata Dahlg. subsp. stricticlada Dahlg. = A. STRICTICLADA
8250 A. DENSIFOLIA BENTH.
A. divaricata Thunb. subsp. brevicarpa Dahlg. = A. BREVICARPA
A. divaricata Thunb. subsp. horizontalis Dahlg. = A. HORIZONTALIS
A. divaricata Thunb. subsp. leptocoma (Eckl. & Zeyh.) Dahlg. = A. LEPTOCOMA
9050 A. EMPETRIFOLIA (DAHLG.) DAHLG.
(=A. retroflexa L. subsp. empetrifolia Dahlg.) 16
A. ericifolia L. subsp. puberula (Eckl. & Zeyh.) Dahlg. = A. PUBERULA
9300 A. ESTERHUYSENIAE DAHLG.
(=A. pumila Dahlg.) 16
A. frankenioides DC. a. chortophila (Eckl. & Zeyh.) Harv. = A. CHORTOPHILA
A. gracilifolia Dahlg. = A. JUNIPERINA SUBSP. GRACILIFOLIA
11600 A. HETEROPHYLLA L. F.
(=A. stachyera Eckl. & Zeyh.) 1
(=Paraspalathus heterophylla ("Thunb.") Presl) 1
A. heterophylla L. f. subsp. lagopus (Thunb.) Dahlg. = A. LOTOIDES SUBSP. LAGOPUS
A. heterophylla L. f. subsp. lotoides (Thunb.) Dahlg. = A. LOTOIDES SUBSP. LOTOIDES
11850 A. HORIZONTALIS (DAHLG.) DAHLG.
(=A. divaricata Thunb. subsp. horizontalis Dahlg.) 16
12600 A. INOPS ECKL. & ZEYH.
(=A. capitella Burch. ex Benth.) 1, 16
(=A. stenophylla Eckl. & Zeyh. subsp. garciana Dahlg.) 16
12970 A. ISOLATA (DAHLG.) DAHLG.
(=A. varians Eckl. & Zeyh. subsp. isolata Dahlg.) 16
13010 A. JOUBERTIANA ECKL. & ZEYH.
A. joubertiana Eckl. & Zeyh. subsp. glabripetala Dahlg. = A. SHAWII SUBSP. GLABRIPETALA
A. joubertiana Eckl. & Zeyh. subsp. longispica Dahlg. = A. SHAWII SUBSP. LONGISPICA
A. joubertiana Eckl. & Zeyh. subsp. shawii (L. Bol.) Dahlg. = A. SHAWII SUBSP. SHAWII
13060 A. JUNIPERINA THUNB. SUBSP. GRACILIFOLIA (DAHLG.) DAHLG.
(=A. gracilifolia Dahlg.) 16
13160 A. JUNIPERINA THUNB. SUBSP. MONTICOLA DAHLG.
13210 A. KATBERGENSIS (DAHLG.) DAHLG.
(=A. simii H. Bol. subsp. katbergensis Dahlg.) 16
13230 A. KEEROMSBERGENSIS DAHLG.
13240 A. KOUGAENSIS (GARAB. EX DAHLG.) DAHLG.
(=A. chortophila Eckl. & Zeyh. subsp. kougaensis Dahlg.) 16
A. lactea Thunb. subsp. adelphea (Eckl. & Zeyh.) Dahlg. = A. SUBTINGENS
A. laricifolia Lam. = A. UNIFLORA
14140 A. LEBECKIOIDES DAHLG.
(=A. linearis (Burm. f.) Dahlg. subsp. latipetala Dahlg.) 16
A. leiantha (Phill.) Dahlg. = A. CRENATA
14350 A. LEPTOCOMA ECKL. & ZEYH.
(=A. divaricata Thunb. subsp. leptocoma (Eckl. & Zeyh.) Dahlg.) 16
A. leptophylla Eckl. & Zeyh. = A. UNIFLORA
14500 A. LEUCOPHYLLA DAHLG.
A. leucophylla Dahlg. subsp. septentrionalis Dahlg. = A. PETERSONII
14570 A. LINEARIFOLIA (BURM. F.) DC.
(=A. linearifolia DC. b. discreta Drege) 1, 16
(=A. rugosa Thunb. subsp. linearifolia (Burm. f.) Dahlg.) 16
(=Trineuria linearifolia (DC.) Presl) 1, 16
A. linearifolia DC. b. discreta Drege = A. LINEARIFOLIA
14600 A. LINEARIS (BURM. F.) DAHLG.
(=A. linearis (Burm. f.) Dahlg. subsp. pinifolia (Marloth) Dahlg.) 16
(=Borbonia pinifolia Marl.) 6, 15, 16
A. linearis (Burm. f.) Dahlg. subsp. latipetala Dahlg. = A. LEBECKIOIDES
A. linearis (Burm. f.) Dahlg. subsp. pinifolia

(Marloth) Dahlg. = A. LINEARIS
15030 A. LOTOIDES THUNB. SUBSP. LAGOPUS (THUNB.) DAHLG.
(=A. heterophylla L. f. subsp. lagopus (Thunb.) Dahlg.) 16
(=Ononis lagopus Thunb.) 1, 16
15050 A. LOTOIDES THUNB. SUBSP. LOTOIDES
(=A. heterophylla L. f. subsp. lotoides (Thunb.) Dahlg.) 16
(=A. procumbens E. Mey.) 1, 16
(=Paraspalathus humifusa Presl) 1, 16
(=Paraspalathus lotoides (Thunb.) Presl) 1, 16
(=Paraspalathus procumbens (E. Mey.) Presl) 1, 16
16050 A. NEGLECTA SALTER
(=A. spicata Thunb. subsp. neglecta (Salter) Dahlg.) 16
A. nervosa E. Mey. = A. SPICATA
16550 A. OBTUSATA THUNB.
(=A. spinosa L. subsp. obtusata (Thunb.) Dahlg.) 16
A. pachyloba Benth. subsp. succulentifolia Dahlg. = A. PACHYLOBA SUBSP. VILLICAULIS
17050 A. PACHYLOBA BENTH. SUBSP. VILLICAULIS DAHLG.
(=A. pachyloba Benth. subsp. succulentifolia Dahlg.) 16
17950 A. PETERSONII DAHLG.
(=A. leucophylla Dahlg. subsp. septentrionalis Dahlg.) 16
A. procumbens E. Mey. = A. LOTOIDES SUBSP. LOTOIDES
18850 A. PUBERULA (ECKL. & ZEYH.) DAHLG.
(=A. ericifolia L. subsp. puberula (Eckl. & Zeyh.) Dahlg.) 16
A. pumila Dahlg. = A. ESTERHUYSENIAE
A. remota Eckl. & Zeyh. = A. SPICATA
A. retroflexa L. subsp. amoena Dahlg. = A. AMOENA
20040 A. RETROFLEXA L. SUBSP. ANGUSTIPETALA DAHLG.
A. retroflexa L. subsp. empetrifolia Dahlg. = A. EMPETRIFOLIA
20800 A. RUGOSA THUNB.
A. rugosa Thunb. subsp. linearifolia (DC.) Dahlg. = A. LINEARIFOLIA
21600 A. SECURIFOLIA ECKL. & ZEYH.
(=A. securifolia Eckl. & Zeyh. subsp. crassa Dahlg.) 16
A. securifolia Eckl. & Zeyh. subsp. crassa Dahlg. = A. SECURIFOLIA
21700 A. SERICEA BERG.
(=Paraspalathus sericea (Berg.) Presl) 1
A. sericea Berg. subsp. aemula (E. Mey.) Dahlg. = A. AEMULA
21910 A. SHAWII L. BOL. SUBSP. GLABRIPETALA DAHLG.
(=A. joubertiana Eckl. & Zeyh. subsp. glabripetala Dahlg.) 16
21920 A. SHAWII L. BOL. SUBSP. LONGISPICA (DAHLG.) DAHLG.
(=A. joubertiana Eckl. & Zeyh. subsp. longispica Dahlg.) 16
21930 A. SHAWII L. BOL. SUBSP. SHAWII
(=A. joubertiana Eckl. & Zeyh. subsp. shawii (L. Bol.) Dahlg.) 16
22000 A. SIMII H. BOL.
A. simii H. Bol. subsp. katbergensis Dahlg. = A. KATBERGENSIS
A. sphaerocephala Schltr. = A. TRUNCATA
22400 A. SPICATA THUNB.
(=A. benthamii Harv.) 5
(=A. nervosa E. Mey.) 5
(=A. remota Eckl. & Zeyh.) 5
A. spicata Thunb. subsp. cliffortioides (H. Bol. in Schltr.) Dahlg. = A. CLIFFORTIOIDES
A. spicata Thunb. subsp. neglecta (Salter) Dahlg. = A. NEGLECTA
A. spinosa L. subsp. obtusata (Thunb.) Dahlg. = A. OBTUSATA
A. stachyera Eckl. & Zeyh. = A. HETEROPHYLLA
22900 A. STENOPHYLLA ECKL. & ZEYR.
(=A. stenophylla Eckl. & Zeyh. subsp. colorata Dahlg.) 16
A. stenophylla Eckl. & Zeyh. subsp. colorata Dahlg. = A. STENOPHYLLA
A. stenophylla Eckl. & Zeyh. subsp. garciana Dahlg. = A. INOPS
23150 A. STRICTICLADA (DAHLG.) DAHLG.
(=A. cuspidata Dahlg. subsp. stricticlada Dahlg.) 16
23350 A. SUBTINGENS ECKL. & ZEYH.
(=A. adelphea Eckl. & Zeyh.) 6, 16
(=A. lactea Thunb. subsp. adelphea (Eckl. & Zeyh.) Dahlg.) 16
24200 A. TRUNCATA ECKL. & ZEYH.
(=A. sphaerocephala Schltr.) 1, 16
(=A. truncata Eckl. & Zeyh. subsp. sphaerocephala (Schltr.) Dahlg.) 16
A. truncata Eckl. & Zeyh. subsp. sphaerocephala (Schltr.) Dahlg. = A. TRUNCATA
24350 A. TULBAGHENSIS DAHLG.
(=A. acuminata Lam. subsp. magniflora Dahlg.) 16
24600 A. UNIFLORA L.
(=A. laricifolia Lam.) 10
(=A. leptophylla Eckl. & Zeyh.) 10
A. uniflora L. subsp. willdenowiana (Benth.) Dahlg. = A. WILLDENOWIANA BENTH.
24800 A. VARIANS ECKL. & ZEYH.
A. varians Eckl. & Zeyh. subsp. isolata Dahlg. = A. ISOLATA

25550 A. WILLDENOWIANA BENTH.
(=A. uniflora L. subsp. willdenowiana (Benth.) Dahlg.) 16

3662050 -Paraspalathus Presl = ASPALATHUS
P. aemula (E. Mey.) Presl = ASPALATHUS AEMULA
P. argentea (L.) Presl = ASPALATHUS CALEDONENSIS
P. heterophylla ("Thunb.") Presl = ASPALATHUS HETEROPHYLLA
P. humifusa Presl = ASPALATHUS LOTOIDES SUBSP. LOTOIDES
P. lotoides (Thunb.) Presl = ASPALATHUS LOTOIDES SUBSP. LOTOIDES
P. procumbens (E. Mey.) Presl = ASPALATHUS LOTOIDES SUBSP. LOTOIDES
P. sericea (Berg.) Presl = ASPALATHUS SERICEA

3662100 -Trineuria Presl = ASPALATHUS
T. linearifolia (DC.) Presl = ASPALATHUS LINEARIFOLIA

3664000 -DICHILUS DC.
2. SCHUTTE & VAN WYK. 1988. S. SFR. J. BOT. 54,2: 182-186.
D. multiflorus Burtt Davy = D. PILOSUS
400 D. PILOSUS CONRATH EX SCHINZ
(=D. multiflorus Burtt Davy) 2
(=D. pilosus Conrath ex Schinz var. multiflorus Burtt Davy) 2
(=D. pilosus Kensit) 2
D. pilosus Conrath ex Schinz var. multiflorus Burtt Davy = D. PILOSUS
D. pilosus Kensit = D. PILOSUS
450 D. REPLEXUS (N.E. BR.) A.L. SCHUTTE

3669000 -CROTALARIA L. Revision: R.M. Polhill (K).
C. lenticula E. Mey. = LOTONONIS LENTICULA

3682000 -CYTISUS L.
C. psoraloides L. = INDIGOFERA PSORALOIDES

3685000 -Ononis L. Southern African species moved to ASPALATHUS, CROTALARIA, INDIGOFERA, LOTONONIS
O. filiformis L. = INDIGOFERA SARMENTOSA
O. lagopus Thunb. = ASPALATHUS LOTOIDES SUBSP. LAGOPUS
O. mauritanica L. = INDIGOFERA MAURITANICA
O. spicata Thunb. = ASPALATHUS AEMULA

3698000 -LOTUS L.
L. filiformis Berg. = INDIGOFERA SARMENTOSA
L. fruticosus Berg. = INDIGOFERA MAURITANICA
L. microphyllus Hook. = INDIGOFERA GRACILIS
L. racemosus Poir. = INDIGOFERA MAURITANICA

3700000 -CYAMOPSIS DC.
100 C. SERRATA SCHINZ
(=Indigofera psammotropha H. Bol.) #

3702000 -INDIGOFERA L. Revision: B. Schrire (PRE).
(Note all species are listed)
1. HARVEY. 1862. FC 2: 163-203.
2. GILLETT. 1958. KEW BULL. ADD. SER. 1: 8.
3. SCHREIBER. 1970. FSWA 60: 38.
4. ROSS. 1972. FL. NATAL 200.
5. GILLETT, POLHILL & VERDCOURT. 1971. FTEA 3,1: 21.
6. HILLIARD & BURTT. 1986. NOTES ROY. BOT. GDN. EDINB. 43: 207-210.
7. JARVIE & STIRTON. 1986. BOTHALIA 16,2: 230.
8. JARVIE & STIRTON. 1987. BOTHALIA 17,1: 1-6.
9. GERMISHUIZEN. 1987. 17,1: 33-34.
#. PRE HERBARIUM PRACTICE, FOLLOWING SCHRIRE.
50 I. ACANTHOCLADA DINTER
(=I. longispina Bak. f. ex Gillett) #
I. acanthorhachis Dinter = LESSERTIA ACANTHORHACHIS
I. accepta N.E. Br. = I. SETIFLORA
I. acutifolia Schinz = I. DISJUNCTA VAR. DISJUNCTA
I. acutisepala Conrath ex Bak. f. = I. ZEYHERI
200 I. ADENOCARPA E. MEY.
300 I. ADENOIDES BAK. F.
I. adonensis E. Mey. = I. POLIOTES
I. adscendens Eckl. & Zeyh. = I. HETEROPHYLLA
I. aeruginis Schweinf. = I. TRIGONELLOIDES
I. affinis Harv. = I. BURKEANA
450 I. ALOPECUROIDES (BURM. F.) DC. VAR. ALOPECUROIDES
(=I. coriacea Ait. var. alopecuroides Harv.) #
470 I. ALOPECUROIDES (BURM. F.) DC. VAR. MINOR E. MEY.
(=I. alopecuroides (Burm. f.) DC. var. minor Eckl. & Zeyh.) #
(=I. coriacea Ait. var. minor (E. Mey.) Harv.) #
(=I. mauritanica (L.) Thunb. var. minor E. Mey.) #
(=I. microphylla Lam.) #
I. alopecuroides E. Mey. non DC. = I. CANDOLLEANA
I. alopecuroides (Burm. f.) DC. var. minor Eckl. & Zeyh. = I. ALOPECUROIDES VAR. MINOR
I. alopecurus Schltr. = I. POLIOSA
550 I. ALPINA ECKL. & ZEYH.
(=I. stipularis Link.) #
600 I. ALTERNANS DC. VAR. ALTERNANS

(=I. effusa E. Mey.) 2
(=I. enneaphylla Eckl. & Zeyh. non L.) #
620 I. ALTERNANS DC. VAR. MACRA BAK.
700 I. AMITINA N.E. BR.
800 I. AMOENA AIT.
I. amoena E. Mey. non Ait. = I. MEYERIANA
900 I. ANABIBENSIS A. SCHREIB.
I. angustata E. Mey. = I. STENOPHYLLA ECKL. & ZEYH.
I. angustifolia Curtis non L. = I. VERRUCOSA
1000 I. ANGUSTIFOLIA L. VAR. ANGUSTIFOLIA
I. angustifolia L. var. brachystachya DC. = I. BRACHYSTACHYA
1050 I. ANGUSTIFOLIA L. VAR. TENUIFOLIA (LAM.) HARV.
(=I. leptocaulis Eckl. & Zeyh.) #
(=I. strigosa Spreng.) #
I. angustifolia Thunb. non L. = I. BRACHYSTACHYA
I. angustiloba Bak. f. = I. TORULOSA VAR. ANGUSTILOBA
I. anil L. = I. SUFFRUTICOSA
I. antennulifera L. Bol. = I. ARENOPHILA
I. aphylla Breit. ex Link. = I. FILIFOLIA THUNB.
1200 I. AQUAE-NITENTIS BREM.
I. arenaria E. Mey. = I. EXIGUA
1300 I. ARENOPHILA SCHINZ
(=I. antennulifera L. Bol.) 2
(=Lotononis omahekensis Dinter ex Schreiber) 3
1400 I. ARGYRAEA ECKL.& ZEYH.
(=I. burchellii E. Mey. var. paucifolia E. Mey.) #
(=I. nivea Willd. ex Spreng.) #
1500 I. ARGYROIDES E. MEY.
(=I. engleri Bak. f.) 2, 3
(=I. saxicola Engl.) 2, 3
1600 I. ARISTATA SPRENG.
I. arrecta Benth. ex Harv. non Hochst. ex A. Rich. = I. CONFUSA
1700 I. ARRECTA HOCHST. EX A. RICH.
I. arthrophylla Eckl. & Zeyh. = I. DENUDATA
1900 I. ASTRAGALINA DC.
2000 I. ATRATA N.E. BR.
I. atrinota N.E. Br. = I. REDUCTA
2100 I. AURICOMA E. MEY.
(=I. auricoma E. Mey. var. cuneata Bak. f.) 2, 3
I. auricoma E. Mey. var. cuneata Bak. f. = I. AURICOMA
I. auricoma E. Mey. var. hololeuca (Benth. ex Harv.) Gillett = I. HOLOLEUCA
2200 I. BAINESII BAK.
(=I. variabilis N.E. Br. p.p.) 2
I. bakeriana Viguier = I. DEMISSA
I. baukeana Vatke = I. SCHIMPERI VAR. BAUKEANA
2300 I. BAUMIANA HARMS
2400 I. BIFRONS E. MEY.
(=I. bifrons E. Mey. var. digitata E. Mey.) #
(=I. burchellii DC. non E. Mey.) #
I. bifrons E. Mey. var. digitata E. Mey. = I. BIFRONS
I. bifrons E. Mey. var. trifoliata E. Mey. = I. CARDIOPHYLLA
2450 I. BIJUGA VOGEL EX WALP.
I. bolusii N.E. Br. = I. SPICATA
2600 I. BRACHYSTACHYA (DC.) E. MEY.
(=I. angustifolia L. var. brachystachya DC.) #
(=I. angustifolia Thunb. non L.) #
I. brevifolia N.E. Br. = I. INYANGANA
2800 I. BUCHANANII BURTT DAVY
I. burchellii DC. non E. Mey. = I. BIFRONS
I. burchellii E. Mey. var. multifolia E. Mey. = I. COLLINA
I. burchellii E. Mey. var. paucifolia E. Mey. = I. ARGYRAEA
2900 I. BURKEANA BENTH. EX HARV.
(=I. affinis Harv.) 2, 3
(=I. gonioides Hochst. ex Bak. var. damarensis Bak. f.) 2, 3
I. ca..a E. Mey. = I. HUMIFUSA
3000 I. CANDICANS AIT.
I. candicans E. Mey. non Ait. = I. HETEROPHYLLA
I. candicans Sieb. = I. FILIFORMIS
3100 I. CANDIDISSIMA DINTER
3150 I. CANDOLLEANA MEISN.
(=Anila mauritanica (L.) Kuntze var. oligantha Kuntze) #
(=I. alopecuroides E. Mey. non DC.) #
(=I. coriacea Ait. var. hirta Harv.) #
(=I. mauritanica (L.) Thunb. var. erecta Eckl. & Zeyh.) #
3200 I. CAPILLARIS THUNB.
3300 I. CARDIOPHYLLA HARV.
(=I. bifrons E. Mey. var. trifoliata E. Mey.) #
I. carinata De Wild. = I. TRITA SUBSP. SUBULATA
3350 I. CECILII N.E. BR.
I. centrota Eckl. & Zeyh. = I. DENUDATA
3400 I. CHARLIERIANA SCHINZ VAR. CHARLIERIANA
3450 I. CHARLIERIANA SCHINZ VAR. LATA GILLETT
3460 I. CHARLIERIANA SCHINZ VAR. SCABERRIMA (SCHINZ) GILLETT
(=I. charlieriana Schinz var. sessilis (Chiov.) Gillett) #
(=I. relaxata N.E. Br.) #
(=I. scaberrima Schinz) #
I. charlieriana Schinz var. sessilis (Chiov.) Gillett = I. CHARLIERIANA VAR. SCABERRIMA
I. cinerascens Eckl. & Zeyh. = I. ZEYHERI
3500 I. CIRCINNATA BENTH. EX HARV.
I. cognata N.E. Br. = I. VICIOIDES VAR. ROGERSII
3550 I. COLLINA ECKL. & ZEYH.
(=I. burchellii E. Mey. var. multifolia E. Mey.) #
3600 I. COLUTEA (BURM. F.) MERR.
(=Galega colutea Burm. f.) 2, 3
(=I. consanguinea Klotzsch) 2
(=I. junodii N.E. Br.) 2
(=I. seticulosa Harv.) 2
(=I. viscosa Lam.) 2
I. commiphoroides Chiov. = I. LUPATANA
3700 I. COMMIXTA N.E. BR.
3800 I. COMOSA N.E. BR.
(=I. malacostachys Benth. ex Harv. var. seminuda N.E. Br.) #
I. compacta N.E. Br. = I. HILARIS
I. complanata Spreng. = I. PSORALOIDES
4000 I. COMPLICATA ECKL. & ZEYH.
4100 I. CONCAVA HARV.
4110 I. CONFUSA PRAIN & BAK. F.
(=I. arrecta Benth. ex Harv. non Hochst. ex A. Rich.) #
(=I. pretoriana Harms) #
I. consanguinea Klotzsch = I. COLUTEA
I. coriacea Ait. = I. MAURITANICA
I. coriacea Ait. var. alopecuroides Harv. = I. ALOPECUROIDES VAR. ALOPECUROIDES
I. coriacea Ait. var. cana Harv. = I. MAURITANICA
I. coriacea Ait. var. hirta Harv. = I. CANDOLLEANA
I. coriacea Ait. var. major E. Mey. = I. MAURITANICA
I. coriacea Ait. var. minor (E. Mey.) Harv. = I. ALOPECUROIDES VAR. MINOR
I. corniculata E. Mey. = I. TRISTIS
I. coronilloides Jaub. & Spach. = I. TRITA SUBSP. SCABRA
4500 I. COSTATA GUILL. & PERR. SUBSP. MACRA (E. MEY.) GILLETT
(=I. macra E. Mey.) 2, 3, 4
4600 I. CREBRA N.E. BR.
4700 I. CRYPTANTHA BENTH. EX HARV. VAR. CRYPTANTHA
4750 I. CRYPTANTHA BENTH. EX HARV. VAR. OCCIDENTALIS BAK. F.
4780 I. CUNEIFOLIA ECKL. & ZEYH. VAR. ANGUSTIFOLIA HARV.
4800 I. CUNEIFOLIA ECKL. & ZEYH. VAR. CUNEIFOLIA
(=I. florida E. Mey.) 1
4900 I. CUNENENSIS TORRE
I. cylindrica DC. = I. FRUTESCENS
5100 I. CYTISOIDES (L.) L.
(=I. lotoides auct. non Lam.) #
(=I. mucronata Lam.) #
(=Psoralea cytisoides L.) #
5200 I. DALEOIDES BENTH. EX HARV. VAR. DALEOIDES
(=I. dodecaphylla Ficalho & Hiern) 2
5250 I. DALEOIDES BENTH. EX HARV. VAR. GOSSWEILERI BAK. F.
(=I. hololeuca Benth. ex Harv. var. angolensis Bak. f.) 2
5300 I. DAMARANA MERXM. & A. SCHREIB.
(=I. wilmaniae Bak. f. ex Gillett) 3
I. dealbata Harv. = I. SPINESCENS
5500 I. DECLINATA E. MEY.
5550 I. DECORA LINDL. *
I. deflexa Hochst. ex A. Rich. = I. PARVIFLORA VAR. PARVIFLORA
5600 I. DELAGOAENSIS BAK. F. EX GILLETT
5700 I. DEMISSA TAUB.
(=I. bakeriana Viguier) 2
5800 I. DENSA N.E. BR.
I. denudata L. f. var. dumosa (E. Mey.) Harv. = I. DENUDATA
I. denudata L. f. var. luxurians Harv. = I. DENUDATA
I. denudata L. f. var. simplicifolia Harv. = I. DENUDATA
5900 I. DENUDATA THUNB.
(=I. arthrophylla Eckl. & Zeyh.) #
(=I. centrota Eckl. & Zeyh.) #
(=I. denudata L. f. var. dumosa (E. Mey.) Harv.) #
(=I. denudata L. f. var. luxurians Harv.) #
(=I. denudata L. f. var. simplicifolia Harv.) #
(=I. dumosa E. Mey.) #
(=I. flexuosa Eckl. & Zeyh.) #
(=I. kraussiana Meisn.) #
(=I. rechodes Eckl. & Zeyh.) #
(=I. rigescens E. Mey. var. inermis E. Mey.) #
(=I. rigescens E. Mey. var. spinosa E. Mey.) #
6000 I. DEPRESSA HARV.
6100 I. DIGITATA THUNB.
6200 I. DILLWYNIOIDES BENTH. EX HARV.
6300 I. DIMIDIATA VOGEL EX WALP.
I. dimorphophylla Schinz = I. TRITA SUBSP. SUBULATA
I. discolor E. Mey. = I. PROCUMBENS VAR. PROCUMBENS
6600 I. DISJUNCTA GILLETT VAR. DISJUNCTA
(=I. acutifolia Schinz) 2, 3
I. dissimilis N.E. Br. = I. VICIOIDES VAR. ROGERSII
6800 I. DISTICHA ECKL. & ZEYH.
(=I. enonensis E. Mey.) #
I. divaricata De Wild. = I. VICIOIDES VAR.

VICIOIDES
I. dodecaphylla Ficalho & Hiern = I. DALEOIDES VAR. DALEOIDES
6900 I. DOLICHOTHYRSA BAK. F.
7000 I. DREGEANA E. MEY.
(=I. gerrardiana Harv.)
I. dumosa E. Mey. = I. DENUDATA
I. echinata Willd. = I. NUMMULARIIFOLIA
I. effusa E. Mey. = I. ALTERNANS VAR. ALTERNANS
7100 I. EGENS N.E. BR.
I. elliptica E. Mey. = I. PAUCIFLORA
I. endecaphylla Jacq. var. angustata Harv. = I. SPICATA
I. engleri Bak. f. = I. ARGYROIDES
I. enneaphylla Eckl. & Zeyh. non L. = I. ALTERNANS VAR. ALTERNANS
I. enonensis E. Mey. = I. DISTICHA
7300 I. ENORMIS N.E. BR.
I. erecta Eckl. & Zeyh. non Thunb. = I. GRACILIS
I. erecta Thunb. = I. PORRECTA VAR. BICOLOR
7500 I. ERIOCARPA E. MEY.
I. eriocarpa E. Mey. var. williamsonii Harv. = I. WILLIAMSONII
7600 I. EVANSIANA BURTT DAVY
(=I. pauxilla N.E. Br.) #
7700 I. EVANSII SCHLTR.
7750 I. EXIGUA ECKL. & ZEYH.
(=I. arenaria E. Mey.) #
I. eylesiana auct. non Gillett = I. PROCUMBENS
I. falcata E. Mey. = I. SESSILIFOLIA
I. falcata E. Mey. var. glaberrima E. Mey. = I. SESSILIFOLIA
I. falcata E. Mey. var. pubescens E. Mey. = I. SESSILIFOLIA
7900 I. FASTIGIATA E. MEY.
(=I. fastigiata E. Mey. var. angustata Harv.) 2, 4
(=I. rostrata Conrath) 2
I. fastigiata E. Mey. var. angustata Harv. = I. FASTIGIATA
I. ferruginea Schum. & Thonn. = I. HIRSUTA VAR. HIRSUTA
8000 I. FILICAULIS ECKL. & ZEYH.
(=I. subtilis E. Mey.) 1
I. filifolia Ker-Gawl. = I. FILIFOLIA
8100 I. FILIFOLIA THUNB.
(=I. aphylla Breit. ex Link.) #
(=I. filifolia Ker-Gawl.) #
(=I. juncea DC.) #
(=I. nuda (Sims) G. Don) #
(=Lebeckia contaminata Ait. f. non Willd.) #
(=Lebeckia contaminata Ker-Gawl. non Thunb.) #
(=Lebeckia nuda Sims) #
8200 I. FILIFORMIS L. F.
(=I. candicans Sieb.) 1
(=I. filiformis L. f. var. adscendens Eckl. & Zeyh.) #
(=I. filiformis L. f. var. planifolia E. Mey.) #
(=I. wynbergensis S. Moore) #
I. filiformis L. f. var. adscendens Eckl. & Zeyh. = I. FILIFORMIS
I. filiformis L. f. var. planifolia E. Mey. = I. FILIFORMIS
8300 I. FILIPES BENTH. EX HARV.
8400 I. FLABELLATA HARV.
8500 I. FLAVICANS BAK.
I. fleckii Bak. f. = I. PECHUELII
I. flexuosa Eckl. & Zeyh. = I. DENUDATA
8700 I. FLORIBUNDA N.E. BR.
I. florida E. Mey. = I. CUNEIFOLIA VAR. CUNEIFOLIA
8800 I. FOLIOSA E. MEY.
(=I. alopecurus Schltr.) #
(=I. vestita Harv.) #
8900 I. FRONDOSA N.E. BR.
9000 I. FRUTESCENS L.
(=I. cylindrica DC.) #
9100 I. FULCRATA HARV.
I. fusca G. Don = I. HIRSUTA VAR. HIRSUTA
9250 I. GAIRDNERIAE HUTCH. EX BAK. F.
9300 I. GALPINII N.E. BR.
I. garkeana auct. non Vatke = I. HOMBLEI
I. gerardiana Wall. ex Bak. = I. HETERANTHA
I. gerrardiana Harv. = I. DREGEANA
9600 I. GIESSII A. SCHREIB.
9650 I. GIFBERGENSIS C.H. STIRTON & J.K. JARVIE
I. glabella Fourc. = I. VERRUCOSA
9700 I. GLAUCESCENS ECKL. & ZEYH.
9800 I. GLOMERATA E. MEY.
I. goniocarpa Bak. f. = I. LUPATANA
I. gonioides Hochst. ex Bak. var. damarensis Bak. f. = I. BURKEANA
9900 I. GRACILIS SPRENG.
(=I. erecta Eckl. & Zeyh. non Thunb.) #
(=I. setacea E. Mey.) #
(=Lotus microphyllus Hook.) #
10000 I. GRATA E. MEY.
I. griquana Schltr. ex A. Zahlbr. = I. LONGEBARBATA
10050 I. GRISOPHYLLA FOURC.
10200 I. GUERRANA TORRE
10300 I. GUTHRIEI H. BOL.
10400 I. HAMULOSA SCHLTR.
10450 I. HANTAMENSIS DIELS
I. hedranophylla Eckl. & Zeyh. = I. SESSILIFOLIA
10500 I. HEDYANTHA ECKL. & ZEYH.
(=I. secunda E. Mey.) #
I. hendecaphylla Jacq. = I. SPICATA
10570 I. HETERANTHA WALL. EX BRANDIS *
(=I. gerardiana Wall. ex Bak.) #
10600 I. HETEROPHYLLA THUNB.
(=I. adscendens Eckl. & Zeyh.) #
(=I. candicans E. Mey. non Ait.) #
(=I. heterophylla Thunb. var. tulbaghensis Bak. f.) #
I. heterophylla Thunb. var. montana Eckl. & Zeyh. = I. SPINESCENS
I. heterophylla Thunb. var. tulbaghensis Bak. f. = I. HETEROPHYLLA
10700 I. HETEROTRICHA DC.
(=I. rudis N.E. Br.) 2, 3
I. heterotricha DC. var. ecklonii Harv. = I. POLIOTES
I. heterotricha Eckl. & Zeyh. non DC. = I. POLIOTES
10800 I. HILARIS ECKL. & ZEYH.
(=I. compacta N.E. Br.) #
(=I. hilaris Eckl. & Zeyh. var. drakensbergensis Bak. f.) #
(=I. hirta E. Mey.) #
(=I. leipzigiae Brem.) #
(=I. patula Bak.) 2
(=I. similis N.E. Br.) 2
(=I. wentzeliana Harms) 2
I. hilaris Eckl. & Zeyh. var. drakensbergensis Bak. f. = I. HILARIS
10900 I. HIRSUTA L. VAR. HIRSUTA
(=I. ferruginea Schum. & Thonn.) 2
(=I. fusca G. Don) 2
I. hirsuta L. var. polystachya Welw. ex Bak. = I. LONGEBARBATA
I. hirta E. Mey. = I. HILARIS
11100 I. HISPIDA ECKL. & ZEYH.
(=I. lotoides E. Mey.) #
(=I. rhodantha Fourc.) #
11300 I. HOCHSTETTERI BAK. SUBSP. STREYANA (MERXM.) A. SCHREIB.
(=I. streyana Merxm.) 3
11350 I. HOFMANNIANA SCHINZ
11400 I. HOLOLEUCA BENTH. EX HARV.
(=I. auricoma E. Mey. var. hololeuca (Benth. ex Harv.) Gillett) #
I. hololeuca Benth. ex Harv. var. angolensis Bak. f. = I. DALEOIDES VAR. GOSSWEILERI
11550 I. HOMBLEI BAK. F. & MARTIN
(=I. garkeana auct. non Vatke) #
11500 I. HOLUBII N.E. BR.
11600 I. HUMIFUSA ECKL. & ZEYH.
(=I. calva E. Mey.) #
11650 I. HYBRIDA N.E. BR.
11700 I. INCANA THUNB.
I. incana Thunb. var. angustistipulata Bak. f. = I. TOMENTOSA
11800 I. INGRATA N.E. BR.
11900 I. INHAMBANENSIS KLOTZSCH
(=I. polycarpa Benth. ex Harv.) 2, 4
I. intermedia Harv. = I. MEYERIANA
11920 I. INYANGANA N.E. BR.
(=I. brevifolia N.E. Br.) #
11950 I. IONII J.K. JARVIE & C.H. STIRTON
I. juncea DC. = I. FILIFOLIA
I. junodii N.E. Br. = I. COLUTEA
I. kraussiana Meisn. = I. DENUDATA
12150 I. KROOKII SCHLTR. EX A. ZAHLBR.
(=I. woodii H. Bol. var. parvifolia H. Bol.) #
12200 I. LANGEBERGENSIS L. BOL.
I. lateritia Bertol. = I. NOTATA
12300 I. LAXERACEMOSA BAK. F.
12400 I. LEENDERTZIAE N.E. BR.
I. leipzigiae Brem. = I. HILARIS
12600 I. LEPIDA ECKL. & ZEYH.
12650 I. LEPTOCARPA ECKL. & ZEYH.
I. leptocaulis Eckl. & Zeyh. = I. ANGUSTIFOLIA VAR. TENUIFOLIA
I. leptophylla E. Mey. = I. VERRUCOSA
12700 I. LIMOSA L. BOL.
12750 I. LOBATA GILLETT
(=Microcharis latifolia Benth. non Mich.) #
12800 I. LONGEBARBATA ENGL.
(=I. griquana Schltr. ex A. Zahlbr.) 2
(=I. hirsuta L. var. polystachya Welw. ex Bak.) 2
(=I. schlechteri Bak. f.) 2, 4
12900 I. LONGIPES N.E. BR.
(=Anila tenuifolia (Lam.) Kuntze var. filifolia Kuntze) #
I. longispina Bak. f. ex Gillett = I. ACANTHOCLADA
I. lotoides E. Mey. = I. HISPIDA
I. lotoides auct. non Lam. = I. CYTISOIDES
13100 I. LUPATANA BAK. F.
(=I. commiphoroides Chiov.) 2
(=I. goniocarpa Bak. f.) 2
13200 I. LYALLI BAK. SUBSP. LYALLI
(=I. obermeijeriae Brem.) 2
13300 I. LYDENBURGENSIS N.E. BR.
I. macra E. Mey. = I. COSTATA SUBSP. MACRA
I. malacostachys Benth. ex Harv. = I. MELANADENIA
I. malacostachys Benth. ex Harv. var. macrura Conrath ex Bak. f. = I. MELANADENIA
I. malacostachys Benth. ex Harv. var. seminuda N.E. Br. = I. COMOSA
13600 I. MARITIMA BAK.
13700 I. MASONAE N.E. BR.
13800 I. MAURITANICA (L.) THUNB.
(=I. coriacea Ait.) #
(=I. coriacea Ait. var. cana Harv.) #

(=I. coriacea Ait. var. major E. Mey.) #
(=Lotus fruticosus Berg.) #
(=Lotus racemosus Poir.) #
(=Ononis mauritanica L.) #
I. mauritanica (L.) Thunb. var. erecta Eckl. & Zeyh. = I. CANDOLLEANA
I. mauritanica (L.) Thunb. var. minor E. Mey. = I. ALOPECUROIDES VAR. MINDR
I. mearnsii Standley = I. SWAZIENSIS VAR. SWAZIENSIS
13900 I. MELANADENIA BENTH. EX HARV.
(=I. malacostachys Benth. ex Harv.) #
(=I. malacostachys Benth. ex Harv. var. macrura Conrath ex Bak. f.) #
14000 I. MERXMUELLERI A. SCHREIB.
14050 I. MEYERIANA ECKL. & ZEYH.
(=I. amoena E. Mey. non Ait.) #
(=I. intermedia Harv.) #
14100 I. MICRANTHA E. MEY.
14200 I. MICROCARPA DESV.
I. microphylla Lam. = I. ALOPECURDIDES VAR. MINOR
14250 I. MIMOSOIDES BAK.
14300 I. MISCHOCARPA SCHLTR.
14400 I. MOLLICOMA N.E. BR.
(=I. nelsonii N.E. Br.) #
I. mollis E. Mey. = I. MDLLIS
14500 I. MOLLIS ECKL. & ZEYH.
(=I. mollis E. Mey.) #
I. moniliformis Bak. f. = I. DRMOCARPOIDES
14600 I. MONOSTACHYA ECKL. & ZEYH.
(=I. oroboides E. Mey.) #
I. mucronata Lam. = I. CYTISOIDES
14700 I. MUNDIANA ECKL. & ZEYH.
I. nana Eckl. & Zeyh. = I. ZEYHERI
14800 I. NATALENSIS H. BOL.
14900 I. NEBROWNIANA GILLETT
(=I. variabilis N.E. Br. p.p.) 2
14950 I. NEGLECTA N.E. BR.
I. nelsonii N.E. Br. = I. MOLLICOMA
I. nigromontana Eckl. & Zeyh. = I. SPINESCENS
I. nitida Salter = I. PSORALOIDES
I. nivea Willd. ex Spreng. =. I. ARGYRAEA
15100 I. NOTATA N.E. BR.
(=I. lateritia Bertol.) #
I. nuda (Sims) G. Don = I. FILIFOLIA
15200 I. NUDICAULIS E. MEY.
15300 I. NUMMULARIIFOLIA LIVERA EX ALSTDN
(=Acanthonotus echinatus (Willd.) Benth.) 2
(=Hedysarum nummulariifolium L.) 2, 3
(=I. echinata Willd.) 2, 3
15400 I. OBCORDATA ECKL. & ZEYH.
I. obermeijeriae Brem. = I. LYALLI SUBSP. LYALLI
15500 I. OBSCURA N.E. BR.
(=I. stricta L. f. var. acuta Harv.) #
I. oliveri Schweinf. ex Engl. = I. SWAZIENSIS VAR. SWAZIENSIS
I. oliveri Schweinf. ex Harms = I. SWAZIENSIS VAR. SWAZIENSIS
15600 I. ORMOCARPOIDES BAK.
(=I. moniliformis Bak. f.) 2
(=I. torulosa Bak.) 2
I. oroboides E. Mey. = I. MONOSTACHYA
15700 I. OVATA L. F.
(=I. sarmentosa L. f. var. latifolia Eckl. & Zeyh.) #
15800 I. OVINA HARV.
15900 I. OXALIDEA WELW. EX BAK.
(=I. supralevis N.E. Br.) 2
16000 I. OXYTROPIS BENTH. EX HARV.
16200 I. PAPPEI FOURC.
I. parkeri Bak. = I. SPICATA
16250 I. PARVIFLORA HEYNE EX WIGHT & ARN. VAR. OCCIDENTALIS GILLETT
16300 I. PARVIFLORA HEYNE EX WIGHT & ARN. VAR. PARVIFLORA
(=I. deflexa Hochst. ex A. Rich.) 2
I. patens Eckl. & Zeyh. = I. SESSILIFOLIA
I. patula Bak. = I. HILARIS
I. pauciflora E. Mey. non Eckl. & Zeyh. = I. STRICTA
16400 I. PAUCIFLORA ECKL. & ZEYH.
(=I. elliptica E. Mey.) #
I. pauxilla N.E. Br. = I. EVANSIANA
16450 I. PEARSONII BAK. F.
16600 I. PECHUELII KUNTZE
(=I. fleckii Bak. f.) #
16660 I. PENTAPHYLLA BURCH. EX HARV. NON MURR.
I. perplexa N.E. Br. = I. SWAZIENSIS VAR. PERPLEXA
16800 I. PLACIDA N.E. BR.
(=Anila rupestris (Eckl. & Zeyh.) Kuntze var. glencoensis Kuntze) #
(=I. rufescens E. Mey.) #
16850 I. PLATYPODA E. MEY.
16900 I. PODOPHYLLA BENTH. EX HARV.
17000 I. POLIOTES ECKL. & ZEYH.
(=I. adonensis E. Mey.) #
(=I. heterotricha DC. var. ecklonii Harv.) #
(=I. heterotricha Eckl. & Zeyh. non DC.) #
(=I. punctata Eckl. & Zeyh. non Thunb.) #
(=I. rupestris Eckl. & Zeyh.) #
I. polycarpa Benth. ex Harv. = I. INHAMBANENSIS
17200 I. PONGOLANA N.E. BR.
17350 I. PORRECTA ECKL. & ZEYH. VAR. BICDLOR HARV.
(=I. erecta Thunb.) #
17300 I. PORRECTA ECKL. & ZEYH. VAR. PORRECTA
17400 I. PRATICOLA BAK. F.
I. pretoriana Harms = I. CONFUSA
I. procumbens E. Mey. = I. PROCUMBENS VAR. CONCOLOR
17550 I. PROCUMBENS L. VAR. CONCOLOR HARV.
(=I. procumbens E. Mey.) #
I. procumbens L. var. discolor (E. Mey.) Harv. = I. PROCUMBENS VAR. PROCUMBENS
17600 I. PROCUMBENS L. VAR. PROCUMBENS
(=I. discolor E. Mey.) #
(=I. procumbens L. var. discolor (E. Mey.) Harv.) #
17610 I. PRDCUMBENS TORRE
(=I. eylesiana auct. non Gillett) #
I. psammotropha H. Bol. = CYAMOPSIS SERRATA
17630 I. PSEUDOEVANSII HILLIARD & BURTT
17650 I. PSEUDO-INDIGOFERA (MERXM.) GILLETT
(=Microcharis galpinii N.E. Br.) 2
(=Microcharis pseudo-indigofera Merxm.) #
I. psilocarpa Schltr. = I. SARMENTOSA
17800 I. PSORALDIDES (L.) L.
(=Cytisus psoraloides L.) #
(=I. complanata Spreng.) #
(=I. nitida Salter) #
I. psoraloides auct. non (L.) L. = I. RACEMOSA
I. punctata Eckl. & Zeyh. non Thunb. = I. POLIOTES
I. punctata Thunb. = I. VERRUCOSA
17900 I. PUNGENS E. MEY.
18000 I. QUINQUEFOLIA E. MEY.
18020 I. RACEMDSA L.
(=I. psoraloides auct. non (L.) L.) #
(=I. trifoliata L.) #
18050 I. RADICIFERA CRONQUIST
18100 I. RAUTANENII BAK. F.
I. rechodes Eckl. & Zeyh. = I. DENUDATA
18200 I. REDUCTA N.E. BR.
(=I. atrinota N.E. Br.) #
18250 I. REFLEXA E. MEY.
18300 I. REHMANNII BAK. F.
I. relaxata N.E. Br. = I. CHARLIERIANA VAR. SCABERRIMA
I. retroflexa Baill. = I. TRITA SUBSP. SCABRA
I. rhodantha Fourc. = I. HISPIDA
18500 I. RHYTIDDCARPA BENTH. EX HARV. SUBSP. RHYTIDOCARPA
I. rigescens E. Mey. var. inermis E. Mey. = I. DENUDATA
I. rigescens E. Mey. var. spinosa E. Mey. = I. DENUDATA
18600 I. RIPAE N.E. BR.
I. rogersii R.E. Fr. = I. VICIOIDES VAR. ROGERSII
I. rostrata Conrath = I. FASTIGIATA
18700 I. RDSTRATA H. BOL.
(=Anila zeyheri (Spreng.) Kuntze var. macrophylla Kuntze) #
18750 I. RUBROGLANDULDSA GERMISHUIZEN
I. rudis N.E. Br. = I. HETEROTRICHA
I. rufescens E. Mey. = I. PLACIDA
I. rupestris Eckl. & Zeyh. = I. POLIOTES
19000 I. SANGUINEA N.E. BR.
19100 I. SARMENTOSA L. F.
(=I. psilocarpa Schltr.) #
(=I. sarmentosa L. f. var. trifoliata E. Mey.) #
(=Lotus filiformis Berg.) #
(=Ononis filiformis L.) #
I. sarmentosa L. f. var. latifolia Eckl. & Zeyh. = I. OVATA
I. sarmentosa L. f. var. trifoliata E. Mey. = I. SARMENTOSA
I. saxicola Engl. = I. ARGYROIDES
I. scaberrima Schinz = I. CHARLIERIANA VAR. SCABERRIMA
I. scabra Roth. = I. TRITA SUBSP. SCABRA
19150 I. SCHIMPERI JAUB. & SPACH VAR. BAUKEANA (VATKE) GILLETT
(=I. baukeana Vatke) 2, 3
19200 I. SCHIMPERI JAUB. & SPACH VAR. SCHIMPERI
(=I. tettensis Klotzsch) 2, 3
19300 I. SCHINZII N.E. BR.
I. schlechteri Bak. f. = I. LDNGEBARBATA
I. secunda E. Mey. = I. HEDYANTHA
I. semlikiensis Robyns & Boutique = I. VICIOIDES VAR. VICIDIDES
19500 I. SESSILIFDLIA DC.
(=I. falcata E. Mey.) 2
(=I. falcata E. Mey. var. glaberrima E. Mey.) #
(=I. falcata E. Mey. var. pubescens E. Mey.) #
(=I. hedranophylla Eckl. & Zeyh.) #
(=I. patens Eckl. & Zeyh.) 2, 3
I. setacea E. Mey. = I. GRACILIS
I. seticulosa Harv. = I. COLUTEA
I. seticulosa Harv. var. luxurians H. Bol. = I. SETOSA
19700 I. SETIFLORA BAK.
(=I. accepta N.E. Br.) 2
19800 I. SETOSA N.E. BR.
(=I. seticulosa Harv. var. luxurians H. Bol.) #
I. setulosa Bertol. = I. VERRUCDSA
19850 I. SIEBERIANA SCHEELE
I. similis N.E. Br. = I. HILARIS
19900 I. SORDIDA BENTH. EX HARV.
20000 I. SPICATA FORSSK.
(=I. bolusii N.E. Br.) 2, 4
(=I. endecaphylla Jacq. var. angustata Harv.) 2, 4
(=I. hendecaphylla Jacq.) 2
(=I. parkeri Bak.) 2

20100 I. SPINESCENS E. MEY.
(=I. dealbata Harv.) #
(=I. heterophylla Thunb. var. montana Eckl. & Zeyh.) #
(=I. nigromontana Eckl. & Zeyh.) #
20200 I. STENOPHYLLA ECKL. & ZEYH.
(=I. angustata E. Mey.) #
(=I. zeyheri Spreng. ex Eckl. & Zeyh. var. trifoliolata Eckl. & Zeyh.) #
I. stipularis Link. = I. ALPINA
I. streyana Merxm. = I. HOCHSTETTERI SUBSP. STREYANA
20400 I. STRICTA L. F.
(=I. pauciflora E. Mey. non Eckl. & Zeyh.) 1
I. stricta L. f. var. acuta Harv. = I. OBSCURA
I. stricta L. f. var. pedunculata Eckl. & Zeyh. = I. ZEYHERI
I. strigosa Spreng. = I. ANGUSTIFOLIA VAR. TENUIFOLIA
20500 I. SUBCORYMBOSA BAK. VAR. EYLESII BAK. F.
I. subincana N.E. Br. = I. TRITA SUBSP. SUBULATA
I. subtilis E. Mey. = I. FILICAULIS
I. subulata Vahl ex Poir. = I. TRITA SUBSP. SUBULATA
I. subulata Vahl ex Poir. var. scabra (Roth) Meikle = I. TRITA SUBSP. SCABRA
20700 I. SUFFRUTICOSA MILL.
(=I. anil L.) #
20800 I. SULCATA DC.
20850 I. SUPERBA C.H. STIRTON
I. supralevis N.E. Br. = I. OXALIDEA
20870 I. SWAZIENSIS H. BOL. VAR. PERPLEXA (N.E. BR.) GILLETT
(=I. perplexa N.E. Br.) 2
20900 I. SWAZIENSIS H. BOL. VAR. SWAZIENSIS
(=I. mearnsii Standley) 2
(=I. oliveri Schweinf. ex Engl.) 2
(=I. oliveri Schweinf. ex Harms) 2
21000 I. TEIXEIRAE TORRE
I. tenuicaulis Klotzsch = I. VICIOIDES VAR. VICIOIDES
21100 I. TENUISSIMA E. MEY.
I. tetragonoloba E. Mey. = I. TRITA SUBSP. SUBULATA
I. tettensis Klotzsch = I. SCHIMPERI VAR. SCHIMPERI
21230 I. THESIOIDES J.K. JARVIE & C.H. STIRTON
21250 I. TINCTORIA L. VAR. ARCUATA GILLETT
21400 I. TOMENTOSA ECKL. & ZEYH.
(=I. incana Thunb. var. angustistipulata Bak. f.) #
I. torulosa Bak. = I. ORMOCARPOIDES
21450 I. TORULOSA E. MEY. VAR. ANGUSTILOBA (BAK. F.) GILLETT
(=I. angustiloba Bak. f.) 2
21500 I. TORULOSA E. MEY. VAR. TORULOSA
I. transvaalensis Bak. f. = I. VICIOIDES VAR. VICIOIDES
I. trifoliata L. = I. RACEMOSA
21550 I. TRIFOLIOIDES BAK. F.
21600 I. TRIGONELLOIDES JAUB. & SPACH
(=I. aeruginis Schweinf.) 2
21700 I. TRIQUETRA E. MEY.
21800 I. TRISTIS E. MEY.
(=I. corniculata E. Mey.) #
21900 I. TRISTOIDES N.E. BR.
21950 I. TRITA L. F. SUBSP. SCABRA (ROTH) DE KORT & THIJSSE
(=I. coronilloides Jaub. & Spach.) 5
(=I. retroflexa Baill.) 5
(=I. scabra Roth.) 5
(=I. subulata Vahl ex Poir. var. scabra (Roth) Meikle) #
(=I. trita L. f. subsp. subulata (Vahl ex Poir.) Ali var. scabra (Roth) Ali) #
(=I. trita L. f. var. scabra (Vahl ex Poir.) Ali) #
22000 I. TRITA L. F. SUBSP. SUBULATA (VAHL EX POIR.) ALI
(=I. carinata De Wild.) 2
(=I. dimorphophylla Schinz) 3
(=I. subincana N.E. Br.) #
(=I. subulata Vahl ex Poir.) 3
(=I. tetragonoloba E. Mey.) #
(=I. trita L. f. subsp. subulata (Vahl ex Poir.) Ali var. subulata) #
(=I. trita L. f. var. subulata (Vahl ex Poir.) Ali) #
I. trita L. f. subsp. subulata (Vahl ex Poir.) Ali var. scabra (Roth) Ali = I. TRITA SUBSP. SCABRA
I. trita L. f. subsp. subulata (Vahl ex Poir.) Ali var. subulata = I. TRITA SUBSP. SUBULATA
I. trita L. f. var. scabra (Vahl ex Poir.) Ali = I. TRITA SUBSP. SCABRA
I. trita L. f. var. subulata (Vahl ex Poir.) Ali = I. TRITA SUBSP. SUBULATA
I. varia E. Mey. = I. VICIOIDES VAR. ROGERSII
I. variabilis N.E. Br. p.p. = I. BAINESII
I. variabilis N.E. Br. p.p. = I. NEBROWNIANA
22200 I. VELUTINA E. MEY.
22300 I. VENUSTA ECKL. & ZEYH.
22350 I. VERRUCOSA ECKL. & ZEYH.
(=I. angustifolia Curtis non L.) #
(=I. glabella Pourr.) #
(=I. leptophylla E. Mey.) #
(=I. punctata Thunb.) #
(=I. setulosa Bertol.) #
(=I. zeyheri Spreng. ex Eckl. & Zeyh. var. leptophylla (E. Mey.) Harv.) #
I. vestita Harv. = I. FOLIOSA
22450 I. VICIOIDES JAUB. & SPACH VAR. ROGERSII (R.E. FR.) GILLETT
(=I. cognata N.E. Br.) 2
(=I. dissimilis N.E. Br.) #
(=I. rogersii R.E. Fr.) 2
(=I. varia E. Mey.) #
22500 I. VICIOIDES JAUB. & SPACH VAR. VICIOIDES
(=I. divaricata De Wild.) 2
(=I. semlikiensis Robyns & Boutique) 2
(=I. tenuicaulis Klotzsch) 2
(=I. transvaalensis Bak. f.) 2, 3
I. viminea E. Mey. = I. ZEYHERI
I. viscosa Lam. = I. COLUTEA
I. wentzeliana Harms = I. HILARIS
22800 I. WILLIAMSONII (HARV.) N.E. BR.
(=I. eriocarpa E. Mey. var. williamsonii Harv.) 2, 4
I. wilmaniae Bak. f. ex Gillett = I. DAMARANA
I. woodii H. Bol. var. intermedia H. Bol. = I. WOODII VAR. WOODII
23050 I. WOODII H. BOL. VAR. LAXA H. BOL.
I. woodii H. Bol. var. parvifolia H. Bol. = I. KROOKII
23000 I. WOODII H. BOL. VAR. WOODII
(=I. woodii H. Bol. var. intermedia H. Bol.) #
I. wynbergensis S. Moore = I. FILIFORMIS
23100 I. ZEYHERI SPRENG. EX ECKL. & ZEYH.
(=Anila zeyheri Kuntze var. normalis Kuntze) #
(=I. acutisepala Conrath ex Bak. f.) #
(=I. cinerascens Eckl. & Zeyh.) #
(=I. nana Eckl. & Zeyh.) #
(=I. stricta L. f. var. pedunculata Eckl. & Zeyh.) #
(=I. viminea E. Mey.) #
I. zeyheri Spreng. ex Eckl. & Zeyh. var. leptophylla (E. Mey.) Harv. = I. VERRUCOSA
I. zeyheri Spreng. ex Eckl. & Zeyh. var. trifoliolata Eckl. & Zeyh. = I. STENOPHYLLA

3702010 -Acanthonotus Benth. = INDIGOFERA
A. echinatus (Willd.) Benth. = INDIGOFERA NUMMULARIIFOLIA

3702020 -Anila Kuntze = INDIGOFERA
A. mauritanica (L.) Kuntze var. oligantha Kuntze = INDIGOFERA CANDOLLEANA
A. rupestris (Eckl. & Zeyh.) Kuntze var. glencoensis Kuntze = INDIGOFERA FLACCIDA
A. tenuifolia (Lam.) Kuntze var. filifolia Kuntze = INDIGOFERA LONGIPES
A. zeyheri (Spreng.) Kuntze var. macrophylla Kuntze = INDIGOFERA ROSTRATA
A. zeyheri Kuntze var. normalis Kuntze = INDIGOFERA ZEYHERI

3703000 -PSORALEA L. Revision: C.H. Stirton (K).
P. cytisoides L. = INDIGOFERA CYTISOIDES

3715000 -Galega L. Southern African species moved to ASPALATHUS, CYCLOPIA, TEPHROSIA
G. colutea Burm. f. = INDIGOFERA COLUTEA
G. humilis Thunb. = TEPHROSIA ANGULATA
G. pallens Ait. = TEPHROSIA CAPENSIS VAR. CAPENSIS

3718000 -TEPHROSIA PERS. Revision: B.D. Schrire (PRE).
#. PRE HERBARIUM PRACTICE, FOLLOWING SCHRIRE.
T. amoena E. Mey. = T. KRAUSSIANA
500 T. ANGULATA E. MEY.
(=Galega humilis Thunb.) #
(=T. pallens (Ait.) Pers.) #
T. angustissima Engl. = T. LONGIPES SUBSP. LONGIPES
T. armitageana Chiov. = T. MACROPODA VAR. MACROPODA
1200 T. CAPENSIS (JACQ.) PERS. VAR. CAPENSIS
(=Galega pallens Ait.) #
(=T. ternatifolia R.G.N. Young) #
T. damarensis Engl. = T. DREGEANA
T. dawsonii Bak. f. = T. LONGIPES SUBSP. LONGIPES
T. dinteri Schinz = T. DREGEANA
2000 T. DREGEANA E. MEY.
(=T. damarensis Engl.) #
(=T. dinteri Schinz) #
4000 T. KRAUSSIANA MEISN.
(=T. amoena E. Mey.) #
T. linearis (Willd.) Pers. subsp. discolor (E. Mey.) Gillett) = T. LINEARIS VAR. DISCOLOR
4200 T. LINEARIS (WILLD.) PERS. VAR. DISCOLOR (E. MEY.) BRUMMITT
(=T. linearis (Willd.) Pers. subsp. discolor (E. Mey.) Gillett) #
4400 T. LONGIPES MEISN. SUBSP. LONGIPES
(=T. angustissima Engl.) 5
(=T. dawsonii Bak. f.) 5
(=T. longipes Meisn. subsp. longipes var. icosisperma Brummitt) 5
(=T. lurida Sond. var. drummondii Brummitt) 5
(=T. lurida Sond. var. lissocarpa

Brummitt) 5
(=T. lurida Sond. var. lurida) 5
T. longipes Meisn. subsp. longipes var. icosisperma Brummitt = T. LONGIPES SUBSP. LONGIPES
T. lurida Sond. var. drummondii Brummitt = T. LDNGIPES SUBSP. LDNGIPES
T. lurida Sond. var. lissocarpa Brummitt = T. LONGIPES SUBSP. LONGIPES
T. lurida Sond. var. lurida = T. LONGIPES SUBSP. LDNCIPES
4700 T. MACROPDDA (E. MEY.) HARV. VAR. MACROPODA
(=T. armitageana Chiov.) #
T. pallens (Ait.) Pers. = T. ANGULATA
6750 T. PURPUREA (L.) PERS. SUBSP. LEPTOSTACHYA (DC.) BRUMMITT VAR. PUBESCENS BAK.
(=T. sparsiflora H.M. Forbes) #
T. sparsiflora H.M. Forbes = T. PURPUREA SUBSP. LEPTDSTACHYA VAR. PUBESCENS BAK.
T. ternatifolia R.G.N. Young = T. CAPENSIS VAR. CAPENSIS

3746000 -Microcharis Benth. = INDIGOFERA
M. galpinii N.E. Br. = INDIGDFERA PSEUDO-INDIGDFERA
M. latifolia Benth non Mich. = INDIGDFERA LOBATA
M. pseudo-indigofera Merxm. = INDIGDFERA PSEUDD-INDIGOFERA

3756000 -LESSERTIA DG. Revision: G.G. du Plessis
3. DINTER. 1932. FEDDE REP. 30: 202.
100 L. ACANTHORHACHIS (DINTER) DINTER
(=Indigofera acanthorhachia Dinter) 3

3773000 -ORNITHOPUS L.
100 O. SATIVUS BROT. *

3778000 -Hedysarum L. Southern African species moved to ALYSICARPUS, DESMODIUM, ERIOSEMA, INDIGDFERA, WIBORGIA
H. canum J.F. Gmel. = DESMODIUM INCANUM
H. gangeticum L. = DESMODIUM GANGETICUM
H. incanum Swartz = DESMODIUM INCANUM
H. lasiocarpum Beauv. = DESMODIUM VELUTINUM
H. maculatum L. = DESMODIUM GANGETICUM
H. nummulariifolium L. = INDIGOFERA NUMMULARIIFOLIA
H. racemosum Aubl. = DESMODIUM INCANUM
H. repandum Vahl = DESMDDIUM REPANDUM
H. salicifolium Poir. = DESMDDIUM SALICIFOLIUM VAR. SALICIFDLIUM
H. tortuosum Swartz = DESMDDIUM TORTUOSUM
H. vaginale L. = ALYSICARPUS VAGINALIS VAR. VAGINALIS
H. velutinum Willd. = DESMODIUM VELUTINUM

3807000 -DESMDDIUM DESV.
2. SCHRIRE. 1988. BDTHALIA 18,1: 11-24.
D. barbatum (L.) Benth. subsp. dimorphum (Welw. ex Bak.) Laundon = D. BARBATUM VAR. DIMORPHUM
300 D. BARBATUM (L.) BENTH. VAR. ARGYREUM (WELW. EX BAK.) SCHUBERT
(=D. dimorphum Welw. ex Bak. var. argyreum Welw. ex Bak.) 2
(=Nicolsonia barbata (L.) DC. var. argyrae (Welw. ex Bak.) Schindl.) 2
400 D. BARBATUM (L.) BENTH. VAR. DIMDRPHUM (WELW. EX BAK.) SCHUBERT
(=D. barbatum (L.) Benth. subsp. dimorphum (Welw. ex Bak.) Laundon) 1, 2
(=D. dimorphum Welw. ex Bak.) 1, 2
(=Nicolsonia barbata (L.) DC. var. dimorpha (Welw. ex Bak.) Schindl.) 1, 2
D. caffrum (E. Mey.) Druce = D. DREGEANUM
D. caffrum Eckl. & Zeyh. = D. REPANDUM
D. canum (J.F. Gmel.) Schinz & Thell. = D. INCANUM
D. dimorphum Welw. ex Bak. = D. BARBATUM VAR. DIMDRPHUM
D. dimorphum Welw. ex Bak. var. argyreum Welw. ex Bak. = D. BARBATUM VAR. ARGYREUM
600 D. DREGEANUM BENTH.
(=D. caffrum (E. Mey.) Druce) 1, 2
(=Nicolsonia caffra E. Mey.) 1, 2
650 D. GANGETICUM (L.) DC.
(=D. gangeticum (L.) DC. var. maculatum (L.) Bak.) 1, 2
(=D. natalitum Sond.) 2
(=Hedysarum gangeticum L.) 1, 2
(=Hedysarum maculatum L.) 1, 2
D. gangeticum (L.) DC. var. maculatum (L.) Bak. = D. CANGETIGUM
D. grande E. Mey. = D. SALICIFOLIUM VAR. SALICIFOLIUM
D. hirtum Guill. & Perr. = D. SETIGERUM
750 D. INCANUM DC.
(=D. canum (J.F. Gmel.) Schinz & Thell.) 2
(=Hedysarum canum J.F. Gmel.) 2
(=Hedysarum incanum Swartz) 2
(=Hedysarum racemosum Aubl.) 2
D. lasiocarpum (Beauv.) DC. = D. VELUTINUM
D. natalitum Sond. = D. GANGETICUM
D. paleaceum Guill. & Perr. = D. SALICIFOLIUM VAR. SALICIFOLIUM
1100 D. REPANDUM (VAHL) DC.
(=D. caffrum Eckl. & Zeyh.) 2
(=D. scalpe DC.) 1, 2
(=D. strangulatum Wight & Arn.) 1, 2
(=Hedysarum repandum Vahl) 1, 2
1200 D. SALICIFOLIUM (POIR.) DC. VAR. SALICIFOLIUM
(=D. grande E. Mey.) 1, 2
(=D. paleaceum Guill. & Perr.) 1, 2
(=Hedysarum salicifolium Poir.) 1, 2
D. scalpe DC. = D. REPANDUM
1300 D. SETIGERUM (E. MEY.) BENTH. EX HARV.
(=D. hirtum Guill. & Perr.) 2
(=Nicolsonia setigera E. Mey.) 1, 2
D. spirale sensu Bak. = D. TDRTUOSUM
D. strangulatum Wight & Arn. = D. REPANDUM
1400 D. TORTUOSUM (SWARTZ) DC.
(=D. spirale sensu Bak.) 1, 2
(=Hedysarum tortuosum Swartz) 1, 2
1500 D. VELUTINUM (WILLD.) DC.
(=D. lasiocarpum (Beauv.) DC.) 2
(=Hedysarum lasiocarpum Beauv.) 1, 2
(=Hedysarum velutinum Willd.) 1, 2

3807010 -Nicolsonia Span. = DESMODIUM
N. barbata (L.) DC. var. argyrae (Welw. ex Bak.) Schindl. = DESMODIUM BARBATUM VAR. ARGYREUM
N. barbata (L.) DC. var. dimorpha (Welw. ex Bak.) Schindl. = DESMDDIUM BARBATUM VAR. DIMDRPHUM
N. caffra E. Mey. = DESMODIUM DREGEANUM
N. setigera E. Mey. = DESMDDIUM SETIGERUM

3808000 -PSEUDARTHRIA WIGHT & ARN.
2. SCHRIRE. 1988. BOTHALIA 18,1: 11-24.

3810000 -ALYSICARPUS DESV.
2. SCHRIRE. 1988. BDTHALIA 18,1: 11-24.
A. glaber E. Mey. = A. RUGOSUS SUBSP. PERENNIRUFUS
200 A. RUGOSUS (WILLD.) DC. SUBSP. PERENNIRUFUS J. LEONARD
(=A. glaber E. Mey.) 2
(=A. violaceus (Forssk.) Schindl.) 2
(=A. wallichi Wight & Arn.) 2
400 A. VAGINALIS (L.) DC. VAR. VAGINALIS
(=Hedysarum vaginale L.) 1, 2
A. violaceus (Forssk.) Schindl. = A. RUGDSUS SUBSP. PERENNIRUFUS
A. wallichi Wight & Arn. = A. RUGOSUS SUBSP. PERENNIRUFUS

3820000 -LESPEDEZA MICHX.
1. SCHRIRE. 1988. BOTHALIA 18,1: 11-24.
100 L. CUNEATA (DU MDNT) G. DON *
(=L. sericea (Thunb.) Miq.) 1
L. sericea (Thunb.) Miq. = L. CUNEATA

3897000 -RHYNCHOSIA LOUR.
4750 R. NYASICA BAK.

3905000 -VIGNA SAVI Revision: B.J. Pienaar (PRE).
#. PRE HERBARIUM PRACTICE, FOLLDWING PIENAAR.
V. decipiens Harv. = V. FRUTESCENS SUBSP. FRUTESCENS VAR. FRUTESCENS
350 V. FRIESIORUM HARMS VAR. FRIESIDRUM
450 V. FRUTESCENS A. RICH. SUBSP. FRUTESCENS VAR. FRUTESCENS
(=V. decipiens Harv.) #
(=V. longiloba Burtt Davy) 1, #
(=V. pongolensis Burtt Davy) 1, #
(=V. pseudotriloba Harms) 1, #
V. huillensis Welw. ex Bak. = V. UNGUICULATA SUBSP. DEKINDTIANA (HARMS.) VERDC.
V. longiloba Burtt Davy = V. FRUTESCENS SUBSP. FRUTESCENS VAR. FRUTESCENS
1020 V. MONDPHYLLA TAUB.
V. pongolensis Burtt Davy = V. FRUTESCENS SUBSP. FRUTESCENS VAR. FRUTESCENS
V. pseudotriloba Harms = V. FRUTESCENS SUBSP. FRUTESCENS VAR. FRUTESCENS
1350 V. PYMAEA R.E. FRIIS VAR. PYGMAEA
1950 V. UNGUICULATA (L.) WALP. SUBSP. DEKINDTIANA (HARMS) VERDC.
(=V. huillensis Welw. ex Bak.) #

3910000 -DOLICHDS L.
3. HILLIARD & BURTT. 1988. NDTES R. BDT. GDN EDINB. 45,1: 83-85.
150 D. ANGUSTISSIMUS E. MEY.

3910020 -MACROTYLDMA (WICHT & ARN.) VERDC.
2. VERDCOURT. 1971. FTEA 4: 581-584.
500 M. UNIFLORUM (LAM.) VERDC. VAR. STENOCARPUM (BRENAN) VERDC.

GERANIACEAE Contributed by B.J. Pienaar 3924000

3926000 -SARCDCAULON (DC.) SWEET Revision: R.O. Moffett (STE).
900 S. PATERSONII (DC.) G. DON

3928000 -PELARGONIUM L'HERIT.
20. NDRDENSTAM. 1987. PL. SYST. EVDL. 155: 333-337.
21. VAN DER WALT & VAN ZYL. 1988. S. AFR. J. BOT. 54,2: 145-171.
22. VAN DER WALT & VDRSTER. 1988. PELARGONIUMS OF SOUTHERN AFRICA 3: 1-149.
900 P. ANETHIFOLIUM (ECKL. & ZEYH.) STEUD.
1400 P. ARIDUM R.A. DYER

(=P. dissectum (Eckl. & Zeyh.) Harv.) 22
2530 P. CAESPITOSUM TURCZ. SUBSP. CAESPITOSUM
2550 P. CAESPITOSUM TURCZ. SUBSP. CONCAVUM HUGO
5000 P. DICHDNDRIFOLIUM DC.
(=P. middletonianum Knuth) 22
P. dissectum (Eckl. & Zeyh.) Harv. = P. ARIDUM
5700 P. ELEGANS (ANDR.) WILLD.
(=P. ovale (Burm. f.) L'Herit. var. ovatum Harv.) 21
P. fumarioides L'Herit. ex Harv. = P. MINIMUM
P. harveyanum Knuth = P. HYPDLEUCUM
8350 P. HYPOLEUCUM TURCZ.
(=P. harveyanum Knuth) 22
9250 P. LAXUM (SWEET) G. DON
P. middletonianum Knuth = P. DICHDNDRIPOLIUM
9930 P. MINIMUM (CAV.) WILLD.
(=P. fumarioides L'Herit. ex Harv.) 22
11350 P. OVALE (BURM. F.) L'HERIT. SUBSP. HYALINUM HUGO
P. ovale (Burm. f.) L'Herit. subsp. ovatum Harv. = P. ELEGANS
11410 P. OVALE (BURM. F.) L'HERIT. SUBSP. VERONICIFOLIUM (ECKL. & ZEYH.) HUGO
(=P. veronicaefolium (Eckl. & Zeyh.) Steud.) 21
P. sidaefolium (Thunb.) Knuth = P. SIDOIDES
16030 P. SIDOIDES DC.
(=P. sidaefolium (Thunb.) Knuth) 22
P. veronicaefolium (Eckl. & Zeyh.) Steud. = P. OVALE SUBSP. VERONICIFOLIUM

RUTACEAE Contributed by M. Jordaan and C.M. van Wyk 3986000

4037000 -AGATHOSMA WILLD. Revision: A. Bean (BOL).
#. PRE HERBARIUM PRACTICE, FOLLOWING BEAN.
11150 A. RUDOLPHII I. WILLIAMS
(=Acmadenia marlothii Duemmer) #

4040000 -ACHADENIA BART. & WENDL. P.
A. marlothii Duemmer = AGATHOSMA RUDOLPHII

4076000 -VEPRIS COMM. EX A. JUSS.
3. BOND & GOLDBLATT. 1984. JL S. APR. BOT. 13: 404.
150 V. LANCEOLATA (LAM.) G. DON
(=Toddalia lanceolata Lam.) 2, 3
(=V. undulata (Thunb.) Verdoorn & C.A. Sm.) 3
V. undulata (Thunb.) Verdoorn & C.A. Sm. = V. LANCEOLATA

4077000 -TDDDALIA JUSS.
T. lanceolata Lam. = VEPRIS LANCEOLATA

BURSERACEAE Contributed by M. Jordaan 4136000

4151000 -COMMIPHORA JACQ. Revision: J.J.A. van der Walt (STE).
3. VAN DER WALT. 1986. FSA 18,3: 5-34.

MELIACEAE (PART A) Contributed by M. Jordaan 4155000

4155000 -CEDRELA P. BR.
2. WHITE & STYLES. 1986. FSA 18,3: 60.

4156000 -TOONA (ENDL.) M.J. RDEM.
2. WHITE & STYLES. 1986. FSA 18,3: 61.

MELIACEAE (PART B) Contributed by M. Jordaan 4159000

4171000 -TURRAEA L.
3. WHITE & STYLES. 1986. PSA 18: 45-47.
400 T. STREYI F. WHITE & STYLES
500 T. ZAMBESICA SPRAGUE & HUTCH.

MALPIGHIACEAE Contributed by M. Jordaan 4201000

4206000 -TRIASPIS BURCH.
250 T. HYPERICOIDES (DC.) BURCH. SUBSP. NELSONII (OLIV.) IMMELMAN
(=T. thorncroftii Burtt Davy) 1
T. thorncroftii Burtt Davy = T. HYPERICOIDES SUBSP. NELSONII

4219000 -SPHEDAMNOCARPUS PLANCH. EX BENTH. & HOOK. F.
3. DE VILLIERS & BOTHA. 1986. FSA 18: 66-69.
#. PRE HERBARIUM PRACTICE, FOLLOWING JORDAAN.
600 S. TRANSVAALICUS (KUNTZE) BURTT DAVY

POLYGALACEAE Contributed by M. Jordaan 4273000

4273000 -POLYGALA L.
##. PRE HERBARIUM PRACTICE, FDLLOWING JORDAAN.
300 P. ALBIDA SCHINZ VAR. ALBIDA
1550 P. EMPETRIFOLIA HOUTT.
(=P. teretifolia Thunb.) ##
P. gagnebiniana Chod. = P. SPHENOPTERA
2450 P. GRACILENTA BURTT DAVY
P. muraltioides Eckl. & Zeyh. = MURALTIA MURALTIOIDES
6900 P. SPHENOPTERA FRESEN.
(=P. gagnebiniana Chod.) #
P. teretifolia Thunb. = P. EMPETRIFOLIA

4278000 -MURALTIA JUSS.
2300 M. CHAMAEPITYS CHOD.
7400 M. MURALTIOIDES (ECKL. & ZEYH.) LEVYNS
(=Polygala muraltioides Eckl. & Zeyh.) 1

DICHAPETALACEAE Contributed by M. Jordaan 4283000

4285000 -TAPURA AUBL.
2. BRETELER. 1987. BELMONTIA 19: 56-60.
100 T. FISCHERI ENGL.
(=T. fischeri Engl. var. pubescens Verdc. & Torre) 2
T. fischeri Engl. var. pubescens Verdc. & Torre = T. FISCHERI

EUPHORBIACEAE Contributed by M. Jordaan 4286000

4295000 -PSEUDOLACHNOSTYLIS PAX
2. RADCLIPPE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 81.
P. dekindtii Pax = P. MAPROUNEIPOLIA
150 P. MAPROUNEIFOLIA PAX VAR. DEKINDTII (PAX) RADCLIPFE-SM.
(=P. dekindtii Pax) 2
200 P. MAPROUNEIPOLIA PAX VAR. MAPROUNEIPOLIA

4299000 -PHYLLANTHUS L.
3. RADCLIFFE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 23.
#. PRE HERBARIUM PRACTICE, POLLOWING JORDAAN.
P. amapondensis Sim = MARGARITARIA DISCOIDEA VAR. PAGIFOLIA
100 P. ASPERULATUS HUTCH.
P. discoideus (Baill.) Muell. Arg. = MARGARITARIA DISCOIDEA VAR. DISCOIDEA
P. flacourtioides Hutch. = MARGARITARIA DISCOIDEA VAR. NITIDA
1100 P. HETEROPHYLLUS E. MEY.
P. kirkianus Muell. Arg. = P. PINNATUS
2250 P. PINNATUS (WIGHT) WEBSTER
(=P. kirkianus Muell. Arg.) 3

4299020 -MARGARITARIA L. P.
2. RADCLIPPE-SMITH. 1987. PTEA EUPHORBIACEAE 1: 67.
M. discoidea (Baill.) Webster subsp. discoidea = M. DISCOIDEA VAR. DISCOIDEA
M. discoidea (Baill.) Webster subsp. nitida (Pax) Webster p.p. = M. DISCOIDEA VAR. PAGIPOLIA
M. discoidea (Baill.) Webster subsp. nitida (Pax) Webster p.p. = M. DISCOIDEA VAR. NITIDA
50 M. DISCOIDEA (BAILL.) WEBSTER VAR. DISCOIDEA
(=M. discoidea (Baill.) Webster subsp. discoidea) 2
(=Phyllanthus discoideus (Baill.) Muell. Arg.) 1
75 M. DISCDIDEA (BAILL.) WEBSTER VAR. FAGIPOLIA (PAX) RADCLIPFE-SM.
(=M. discoidea (Baill.) Webster subsp. nitida (Pax) Webster p.p.) 2
(=Phyllanthus amapondensis Sim) 1
100 M. DISCOIDEA (BAILL.) WEBSTER VAR. NITIDA (PAX) RADCLIPPE-SM.
(=M. discoidea (Baill.) Webster subsp. nitida (Pax) Webster p.p.) 2
(=Phyllanthus flacourtioides Hutch.) 2

4309000 -DRYPETES VAHL
2. RADCLIPPE-SMITH. 1987. PTEA EUPHORBIACEAE 1: 98.
#. PRE HERBARIUM PRACTICE, FOLLOWING JORDAAN.
200 D. GERRARDII HUTCH.
(=D. gerrardii Hutch. var. tomentosa Radcliffe-Sm.) #
D. gerrardii Hutch. var. tomentosa Radcliffe-Sm. = D. GERRARDII

4327000 -ANTIDESMA L.
3. LEONARD. 1987. BULL. JARD. BOT. NAT. BELG. 57: 453-454.
50 A. RUPESCENS TUL.
(=A. venosum auct. non E. Mey. ex Tul.) 3
A. venosum auct. non E. Mey. ex Tul = A. RUFESCENS

4343000 -CLEISTANTHUS HOOK. F. EX PLANCH.
3. RADCLIPPE-SMITH. 1987. PTEA EUPHORBIACEAE 1: 133.
100 C. SCHLECHTERI (PAX) HUTCH. VAR. SCHLECHTERI

4345000 -BRIDELIA WILLD.
5. RADCLIPPE-SMITH. 1987. PTEA EUPHORBIACEAE 1: 125.

4348000 -CROTON L.
4. RADCLIPPE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 135-160.
400 C. MADANDENSIS S. MOORE
1100 C. SYLVATICUS HOCHST.

4361000 -CAPERONIA ST. HIL.
3. RADCLIPPE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 164.

4367000 -MICROCOCCA BENTH.
3. RADCLIPPE-SMITH. 1987. PTEA EUPHORBIACEAE 1: 260-264.

4368000 -ERYTHROCOCCA BENTH.
4. RADCLIPPE-SMITH. 1987. PTEA EUPHORBIACEAE 1: 271.

4388000 -ALCHORNEA SWARTZ
3. RADCLIPPE-SMITH. 1987. PTEA EUPHORBIACEAE

1: 251-260.

4407000 -ACALYPHA L.
3. RADCLIFFE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 185-213.
800 A. FRUTICOSA FORSSK. VAR. FRUTICOSA
A. senensis Klotzsch = A. VILLICAULIS
2550 A. VILLICAULIS A. RICH.
(=A. senensis Klotzsch) 3

4416000 -TRAGIA L.
3. RADCLIFFE-SMITH. 1987. KEW BULL. 42,2: 396-397.
T. durbanensis Kuntze = T. GLABRATA VAR. GLABRATA
450 T. GLABRATA (MUELL. ARG.) PAX & HOFFM. VAR. GLABRATA
(=T. durbanensis Kuntze) 3
T. natalensis Sond. = TRAGIELLA NATALENSIS
1050 T. PRIONOIDES RADCLIFFE-SM.

4416020 -TRAGIELLA PAX & K. HOFFM.
1. RADCLIFFE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 320.
T. NATALENSIS (SOND.) PAX & K. HOFFM.
(=Sphaerostylis natalensis (Sond.) Croizat) 1
(=Tragia natalensis Sond.) 1

4419000 -Sphaerostylis Baill. Southern African taxa moved to TRAGIELLA
S. natalensis (Sond.) Croizat = TRAGIELLA NATALENSIS

4422000 -DALECHAMPIA L.
3. RADCLIFFE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 287.
100 D. CAPENSIS SPRENG. F.
(=D. kirkii Prain) 3
D. kirkii Prain = D. CAPENSIS
400 D. SCANDENS L. VAR. CORDOFANA (WEBB) MUELL. ARG.

4428000 -ALEURITES FORST.
A. fordii Hemsl. * = VERNICIA FORDII
A. montana (Lour.) Wilson * = VERNICIA MONTANA

4428010 -VERNICIA LOUR.
1. RADCLIFFE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 181.
100 V. FORDII (HEMSL.) AIRY SHAW *
(=Aleurites fordii Hemsl.) 1
200 V. MONTANA LOUR. *
(=Aleurites montana (Lour.) Wilson) 1

4433000 -JATROPHA L.
2. RADCLIFFE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 343-365.
J. messinica E.A. Bruce = J. SPICATA
1300 J. SPICATA PAX
(=J. messinica E.A. Bruce) 2

4444000 -MANIHOT MILL.
2. RADCLIFFE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 367.
50 M. ESCULENTA CRANTZ *
(=M. utilissima Pohl *) 2
M. utilissima Pohl * = M. ESCULENTA *

4448000 -CLUTIA L. Revision: D. Koutnik (BOL) & G.L. Webster (DAV).
4. RADCLIFFE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 332-339.

4464000 -SUREGADA ROXB. EX ROTTL.
2. RADCLIFFE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 376-377.

4483000 -SAPIUM P.BR.
4. RADCLIFFE-SMITH. 1987. FTEA EUPHORBIACEAE 1: 390.
100 S. ELLIPTICUM (KRAUSS) PAX

4498000 -EUPHORBIA L.
7. LEACH. 1986. S. AFR. J. BOT. 52: 369-371.
8. LEACH. 1986. S. AFR. J. BOT. 52,4: 369-371.
9. LEACH. 1986. S. AFR. J. BOT. 54,5: 501-503.
10. LEACH. 1986. S. AFR. J. BOT. 54,6: 534-540.
##. PRE HERBARIUM PRACTICE, FOLLOWING LEISTNER & JORDAAN.
1150 E. ANOPLIA STAPF
2150 E. BAYERI LEACH
6150 E. CYATHOPHORA J. MURR. *
(=Poinsettia cyathophora (J. Murr.) Bartl. *) ##
10000 E. GENICULATA ORTEG. *
(=Poinsettia geniculata (Orteg.) Klotzsch & Garcke) ## *
10200 E. GENTILIS N.E. BR. SUBSP. GENTILIS
10226 E. GENTILIS N.E. BR. SUBSP. TANQUANA LEACH
19850 E. PROEMONTANA LEACH
23950 E. SILICIICOLA DINTER
27150 E. VAALPUTSIANA LEACH

4498020 -POINSETTIA R. GRAH.
#. PRE HERBARIUM PRACTICE, FOLLOWING LEISTNER & JORDAAN.
P. cyathophora (J. Murr.) Bartl. * = EUPHORBIA CYATHOPHORA
P. geniculata (Orteg.) Small * = EUPHORBIA GENICULATA

ANACARDIACEAE Contributed by M. Jordaan 4543000

4563000 -LANNEA A. RICH.
350 L. SCHIMPERI (HOCHST. EX A. RICH.) ENGL. VAR. SCHIMPERI

4594000 -RHUS L.
4. MOFFETT. 1988. S. AFR. J. BOT. 54,2: 172.
100 R. ACOCKSII MOFFETT
600 R. BOLUSII SOND. EX ENGL.
900 R. CILIATA LICHT. EX SCHULT.
3800 R. LAEVIGATA L.
(=R. laevigata L. var. atomaria (Jacq.) R. Fernandes) #
(=R. laevigata L. var. latifolia (Schonl.) R. Fernandes) #
(=R. laevigata L. var. villosa (L. f.) R. Fernandes) #
R. laevigata L. var. atomaria (Jacq.) R. Fernandes = R. LAEVIGATA
R. laevigata L. var. latifolia (Schonl.)R. Fernandes = R. LAEVIGATA
R. laevigata L. var. villosa (L. f.) R. Fernandes = R. LAEVIGATA
R. longispina sensu Schonl. p.p. non Eckl. & Zeyh = R. PTEROTA
5560 R. PTEROTA PRESL
(=R. longispina sensu Schonl. p.p. non Eckl. & Zeyh) #

CELASTRACEAE Contributed by M. Jordaan 4618000

4625000 -Celastrus L. Southern African taxa placed in MAYTENUS and PUTTERLICKIA
C. cordatus E. Mey. ex Sond. = MAYTENUS CORDATA
C. procumbens L. f. = MAYTENUS PROCUMBENS

4626000 -MAYTENUS MOLINA
#. PRE HERBARIUM PRACTICE, FOLLOWING JORDAAN.
350 M. CORDATA (E. MEY. EX SOND.) LOES.
(=Celastrus cordatus E. Mey. ex Sond.) #
(=Gymnosporia cordata (E. Mey. ex Sond.) Sim) #
1400 M. PROCUMBENS (L. F.) LOES.
(=Celastrus procumbens L. f.) 1
(=Gymnosporia procumbens (L. f.) Loes.) 1

4626010 -EMPLEURIDIUM SOND.
1. GOLDBLATT, TOBE ET AL. 1985. ANN. MISSOURI BOT. GDN. 72: 167-183.
100 E. JUNIPERINUM SOND.

4627000 -Gymnosporia (Wight & Arn.) Hook. f. = MAYTENUS
G. cordata (E. Mey. ex Sond.) Sim = MAYTENUS CORDATA
G. procumbens (L. f.) Loes. = MAYTENUS PROCUMBENS

4628000 -PUTTERLICKIA ENDL. Revision: A.E. van Wyk (PRU).
1. DAVISON. 1927. BOTHALIA 2: 336-338.
3. VAN WYK & MOSTERT. 1987. S. AFR. J. BOT. 53,4: 267-270.
150 P. RETROSPINOSA VAN WYK & MOSTERT

4630000 -PTEROCELASTRUS MEISN.
1. DAVISON. 1927. BOTHALIA 2: 321-326.

4641000 -CASSINE L.
1. DAVISON. 1927. BOTHALIA 2: 326-336.

SAPINDACEAE Contributed by M. Jordaan 4723000

4726000 -CARDIOSPERMUM L.
200 C. GRANDIFLORUM SWARTZ
300 C. HALICACABUM L. VAR. HALICACABUM
350 C. HALICACABUM L. VAR. MICROCARPUM (KUNTH) BLUME
(=C. microcarpum Kunth) 1
C. microcarpum Kunth = C. HALICACABUM VAR. MICROCARPUM

MELIANTHACEAE Contributed by M. Jordaan 4853000

4853000 -BERSAMA FRESEN. Revision: P.O.F. Kok (PRU).

TILIACEAE Contributed by M. Jordaan 4937000

4975000 -TRIUMFETTA L.
1. WILD. 1984. FSA 21,1: 20-28.

MALVACEAE Contributed by M. Jordaan 4980000

4990000 -LAVATERA L.
150 L. ASSURGENTIFLORA KELLOGG *
(Garden escape collected in the Cape. 2916 (PORT NOLLOTH): Port Nolloth (-BD) Zietsman 821)

5019000 -CIENFUEGOSIA CAV.
C. anomala (Wawra ex Wawra & Peyr.) Guerke = GOSSYPIUM ANOMALUM
C. triphylla (Harv.) K. Schum. = GOSSYPIUM TRIPHYLLUM

5020000 -GOSSYPIUM L.
3. VOLLESEN. 1987. KEW BULL. 42,2: 337-349.
100 G. ANOMALUM WAWRA EX WAWRA & PEYR. SUBSP. ANOMALUM

(=Cienfuegosia anomala (Wawra ex Wawra & Peyr.) Guerke) 2
G. anomalum Wawra ex Wawra & Peyr. subsp. triphyllum (Harv.) Roberty = G. TRIPHYLLUM
200 G. HERBACEUM L. SUBSP. AFRICANUM (WATT) VOLLESEN
(=G. herbaceum L. var. africanum (Watt) Hutch. & Ghose) 3
(=G. obtusifolium Roxb. ex G. Don var. africanum Watt) 1
(=G. transvaalense Watt) 3
G. herbaceum L. var. africanum (watt) Hutch. & Ghose = G. HERBACEUM SUBSP. AFRICANUM
G. obtusifolium Roxb.ex G. Don var. africanum Watt = G. HERBACEUM SUBSP. AFRICANUM
G. transvaalense Watt = G. HERBACEUM SUBSP. AFRICANUM
(=Cienfuegosia triphylla (Harv.) K. Schum.) 2
(=G. anomalum Wawra ex Wawra & Peyr. subsp. triphyllum (Harv.) Roberty) 3

STERCULIACEAE Contributed by K. Immelman 5044000

5056000 -HERMANNIA L. Revision: B. de Winter (PRE).
H. abyssinica (Harv.) K. Schum. = H. QUARTINIANA SUBSP. STELLULATA
H. adenotricha K. Schum. = H. QUARTINIANA SUBSP. STELLULATA
8550 H. ERODIOIDES (BURCH. EX DC.) KUNTZE
(=H. resedifolia (Burch.) R.A. Dyer) #
(=Mahernia resedaefolia Burch.) #
H. exilis Burtt Davy = H. QUARTINIANA SUBSP. STELLULATA
H. geminiflora Dinter & Engl. = H. QUARTINIANA SUBSP. STELLULATA
13300 H. HETEROPHYLLA (CAV.) THUNB.
(=H. humifusa Hochr.) #
(=H. humilis Thunb.) #
H. humifusa Hochr. = H. HETEROPHYLLA
H. humilis Thunb. = H. HETEROPHYLLA
15100 H. JACOBEIFOLIA (TURCZ.) R.A. DYER
17700 H. MARGINATA (TURCZ.) PILLANS
23200 H. QUARTINIANA A. RICH. SUBSP. STELLULATA (K. SCHUM.) DE WINTER
(=H. abyssinica (Harv.) K. Schum.) 1
(=H. adenotricha K. Schum.) #
(=H. exilis Burtt Davy) #
(=H. geminiflora Dinter & Engl.) 1
(=H. schinzii K. Schum.) 1
(=H. sinuata Burtt Davy) #
(=H. stellulata (Harv.) K. Schum.) #
(=Mahernia abyssinica Hochst. ex Harv.) 1, #
(=Mahernia stellulata Harv.) #
H. resedifolia (Burch.) R.A. Dyer = H. ERODIOIDES
H. schinzii K. Schum. = H. QUARTINIANA SUBSP. STELLULATA
H. sinuata Burtt Davy = H. QUARTINIANA SUBSP. STELLULATA
H. stellulata (Harv.) K. Schum. = H. QUARTINIANA SUBSP. STELLULATA

5056010 -Mahernia Schum. = HERMANNIA
M. abyssinica Hochst. ex Harv. = HERMANNIA QUARTINIANA SUBSP. STELLULATA
M. resedaefolia Burch. = HERMANNIA ERODIOIDES
M. stellulata Harv. = HERMANNIA QUARTINIANA SUBSP. STELLULATA

BEGONIACEAE Contributed by C.M. van Wyk 5396000

5397000 -BEGONIA L.
1300 B. SUTHERLANDII HOOK. F.

THYMELAEACEAE Contributed by C.M. van Wyk 5429000

5435000 -GNIDIA L.
320 G. CAFFRA (MEISN.) GILG
2100 G. GYMNOSTACHYA (C.A. MEY.) GILG
G. hoepfneriana Gilg = G. KRAUSSIANA VAR. KRAUSSIANA
2700 G. KRAUSSIANA MEISN. VAR. KRAUSSIANA
(=G. hoepfneriana Gilg.) 14
(=Lasiosiphon hoepfnerianus Vatke ex Gilg) 5, 14
5950 G. SIMILIS C.H. WR.

5435010 -Lasiosiphon Fresen. = GNIDIA
L. hoepfnerianus Vatke ex Gilg = GNIDIA KRAUSSIANA VAR. KRAUSSIANA

LYTHRACEAE Contributed by K. Immelman 5473000

5474000 -AMMANNIA L.
#. PRE HERBARIUM PRACTICE, FOLLOWING IMMELMAN.
200 A. BACCIFERA L.
(=A. wormskioldii Fisch. & C.A. Mey.) #
(=A. wormskioldii Fisch. & C.A. Mey. var. alata Koehne) #
400 A. SENEGALENSIS LAM. EX POIR.
A. wormskioldii Fisch. & C.A. Mey. = A. BACCIFERA
A. wormskioldia Fisch. & C.A. Mey. var. alata Koehne = A. BACCIFERA

5476000 -LYTHRUM L.
2. SONDER. 1894. FC 2: 516.

5486000 -NESAEA COMM. EX JUSS.
100 N. ANAGALLOIDES KOEHNE
(=N. loandensis auct. non (Welw. ex Hiern) Koehne) #
500 N. DINTERI KOEHNE
(=N. transvaalica Fernandes) #
N. floribunda Sond. = N. RADICANS VAR. FLORIBUNDA
N. kuntzei Koehne = N. SCHINZII
N. loandensis auct. non (Welw. ex Hiern) Koehne = N. ANAGALLOIDES
1100 N. ONDONGANA KOEHNE
(=N. ondonga subsp. ondonga var. evansiana (A. Fernandes & Diniz) A. Fernandes) #
N. ondonga subsp. ondonga var. evansiana (A. Fernandes & Diniz) A. Fernandes = N. ONDONGA
1190 N. RADICANS GUILL. & PERR. VAR. FLORIBUNDA (SOND.) A. FERNANDES
(=N. floribunda Sond.) #
1195 N. RADICANS GUILL. & PERR. VAR. RADICANS
N. rivulare (Wood & Evans) Koehne = N. SCHINZII
1800 N. SARCOPHYLLA (WELW. EX HIERN) KOEHNE
1900 N. SCHINZII KOEHNE
(=N. kuntzei Koehne) #
(=N. rivulare (Wood & Evans) Koehne) #
N. transvaalica Fernandes = N. DINTERI

RHYNCHOCALYCACEAE Contributed by K. Immelman 5495000

5495000 -RHYNCHOCALYX OLIV.
2. TOBE & RAVEN. 1984. ANN. MISSOURI BOT. GDN 41: 836-843.

COMBRETACEAE Contributed by C.M. van Wyk 5536000

5538000 -COMBRETUM LOEFL. Revision: E.F. Hennessy (U. D-W.).
600 C. CELASTROIDES WELW. EX LAWS.

ONAGRACEAE Contributed by C.M. van Wyk 5791000

5819000 -GAURA L.
200 G. LINDHEIMERI ENGELM. & GRAY *

ARALIACEAE Contributed by C.M. van Wyk 5839000

5872010 -SEEMANNARALIA VIG.
100 S. GERRARDII (SEEMANN) HARMS

APIACEAE Contributed by C.M. van Wyk 5893000

5918000 -SANICULA L.
100 S. ELATA BUCH.-HAM. EX D. DON

5970000 -CONIUM L.
100 C. CHAEROPHYLLOIDES (THUNB.) SOND.

5994000 -BUPLEURUM L.
B. difforme L. = ANGINON DIFFORMIS

5994010 -ANGINON RAF.
1. BURTT. 1988. NOTES R. BOT. GDN EDINB. 45,1: 90-91.
100 A. DIFFORME (L.) B.L. BURTT
(=Bupleurum difforme L.) 1
(=Rhyticarpus difformis (L.) Briq.) 1
200 A. RUGOSUM (THUNB.) RAF.
(=Rhyticarpus rugosus (Thunb.) Sond.) 1
300 A. SWELLENDAMENSIS (ECKL. & ZEYH.) B.L. BURTT
(=Rhyticarpus ecklonis Sond.) 1
(=Rhyticarpus swellendamensis (Eckl. & Zeyh.) Briq.) 1

5996000 -Rhyticarpus Sond. = ANGINON
R. difformis (L.) Briq. = ANGINON DIFFORME
R. ecklonis Sond. = ANGINON SWELLENDAMENSIS
R. rugosus Sond. = ANGINON RUGOSUM
R. swellendamensis (Eckl. & Zeyh.) Briq. = ANGINON SWELLENDAMENSIS

6013000 -DEVERRA DC.
300 D. DENUDATA (VIV.) PFISTERER & PODL. SUBSP. APHYLLA (CHAM. & SCHLECHTD.) PFISTERER & PODL.

6046010 -Thunbergiella Wolff = ITASINA
T. filiformis (Koso-Poljansky) Wolff = ITASINA FILIFOLIA

6046020 -ITASINA RAF.
1. BURTT. 1988. NOTES R. BOT. GDN EDINB. 45,1: 93-94.
100 I. FILIFOLIA (THUNB.) RAF.
(=Thunbergiella filiformis (Koso-Poljansky) Wolff) 1

6054000 -DIPLOLOPHIUM TURCZ.

6062000 -FOENICULUM MILL.
F. VULGARE MILL. *

6069000 -Heteroptilis E. Mey. ex Meisn. = DASISPERMUM
H. suffruticosa (Berg.) Leute = DASISPERMUM SUFFRUTICOSUM

6069010 -Cnidium Cusson = DASISPERMUM
C. suffruticosum Cham. & Schlechtd. = DASISPERMUM SUFFRUTICOSUM

6069020 -DASISPERMUM RAF.

1. BURTT. 1988. NOTES R. BOT. GDN EDINB. 45,1: 92-93.
100 D. SUFFRUTICOSUM (BERG.) B.L. BURTT
(=Cnidium suffruticosum Cham. & Schlechtd.) 1
(=Heteroptilis suffruticosa (Berg.) Leute) 1

6078000 -ANNESORRHIZA CHAM. & SCHLECHTD.
7. BURTT. 1988. NOTES R. BOT. GDN EDINB. 45,1: 92.
A. gummifera (L.) Jackson = A. INEBRIANS
650 A. INEBRIANS (THUNB.) WIJNANDS
(=A. gummifera (L.) Jackson) 6
(=Glia gummifera (L.) Sond.) 6

6078010 -Glia Sond. = ANNESORRHIZA
G. gummifera (L.) Sond. = ANNESORRHIZA INEBRIANS

6116000 -PEUCEDANUM L.
3. BENTHAM & HOOKER. 1867. GEN 1,3: 902.
5. DRUDE. 1898. PFLANZENFAM. 3,8: 237.
7. PHILLIPS. 1917. ANN. S. AFR. MUS. 16: 108.
14. BURTT. 1988. NOTES R. BOT. GDN EDINB. 45,1: 94.
3100 P. UPINGTONIAE (SCHINZ) DRUDE
(=Lefebvrea upingtoniae Schinz) 5

6116020 -Lefebvrea A. Rich. = PEUCEDANUM
L. upingtoniae Schinz = PEUCEDANUM UPINGTONIAE

ERICACEAE Contributed by C.M. van Wyk 6179000

6237000 -ERICA L.
28. OLIVER. 1987. S. AFR. J. BOT. 53,6: 455-458.
E. accommodata Klotzsch ex Benth. var. ebracteata H. Bol. = E. LASCIVA
1940 E. ALTIPHILA E.G.H. OLIVER
(=Philippia alticola E.G.H. Oliver) 28
(=Philippia tristis H. Bol.) 28
19780 E. DRACOMONTANA E.G.H. OLIVER
(=Philippia drakensbergensis E.G.H. Oliver) 28
20650 E. ELSIEANA (E.G.H. OLIVER) E.G.H. OLIVER
(=Philippia elsieana E.G.H. Oliver) 28
21530 E. ESTERIANA E.G.H. OLIVER SUBSP. ESTERIANA
(=Philippia esterhuyseniae E.G.H. Oliver subsp. esterhuyseniae) 28
21570 E. ESTERIANA E.G.H. OLIVER SUBSP. SWARTBERGENSIS (E.G.H. OLIVER) E.G.H. OLIVER
(=Philippia esterhuyseniae E.G.H. Oliver subsp. swartbergensis E.G.H. Oliver) 28
21860 E. EVANSII (N.E. BR.) E.G.H. OLIVER
(=Philippia evansii N.E. Br.) 28
21940 E. EXLEEANA E.G.H. OLIVER
(=Philippia leeana Klotzsch) 28
(=E. accommodata Klotzsch var. ebracteata H. Bol.) 28
(=Philippia stokoei L. Guthrie) 28
40320 E. MADIDA E.G.H. OLIVER
(=Philippia irrorata E.G.H. Oliver) 28
44740 E. NOTHOLEEANA (E.G.H. OLIVER) E.G.H. OLIVER
(=Philippia notholeeana E.G.H. Oliver) 28
(=Philippia pallida L. Guthrie) 28
50350 E. PETRICOLA E.G.H. OLIVER
(=Philippia petrophila E.G.H. Oliver) 28
53140 E. PROCAVIANA (E.G.H. OLIVER) E.G.H. OLIVER
(=Philippia procaviana E.G.H. Oliver) 28
59070 E. SIMII (S. MOORE) E.G.H. OLIVER
(=Philippia simii S. Moore) 28
64840 E. TRISTIS BARTL.
(=Philippia absinthoides (Thunb.) E.G.H. Oliver) 28
(=Philippia chamissonis Klotzsch) 28

6240000 -Philippia Klotzsch = ERICA
P. absinthoides (Thunb.) E.G.H. Oliver = ERICA TRISTIS
P. alticola E.G.H. Oliver = ERICA ALTIPHILA
P. chamissonis Klotzsch = ERICA TRISTIS
P. drakensbergensis E.G.H. Oliver = ERICA DRACOMONTANA
P. elsieana E.G.H. Oliver = ERICA ELSIEANA
P. esterhuyseniae E.G.H. Oliver subsp. esterhuyseniae = ERICA ESTERIANA SUBSP. ESTERIANA
P. esterhuyseniae E.G.H. Oliver subsp. swartbergensis E.G.H. Oliver = ERICA ESTERIANA SUBSP. SWARTBERGENSIS
P. evansii N.E. Br. = ERICA EVANSII
P. irrorata E.G.H. Oliver = ERICA MADIDA
P. leeana Klotzsch = ERICA EXLEEANA
P. notholeeana E.G.H. Oliver = ERICA NOTHOLEEANA
P. pallida L. Guthrie = ERICA PELTATA
P. petrophila E.G.H. Oliver = ERICA PETRICOLA
P. procaviana E.G.H. Oliver = ERICA PROCAVIANA
P. simii S. Moore = ERICA SIMII
P. stokoei L. Guthrie = ERICA ACCOMMODATA VAR. EBRACTEATA
P. tristis H. Bol. = ERICA CAESPITOSA

SAPOTACEAE Contributed by C.M. van Wyk 6353000

6386020 -VITELLARIOPSIS (BAILL.) DUBARD
100 V. DISPAR (N.E. BR.) AUBREV.
(=Austromimusops dispar (N.E. Br.) A. Meeuse) 1
200 V. MARGINATA (N.E. BR.) AUBREV.
(=Austromimusops marginata (N.E. Br.) A. Meeuse) 1

LOGANIACEAE Contributed by M. Jordaan 6447000

6460000 -STRYCHNOS L.
S. innocua Del. subsp. dysophylla (Benth.) Verdoorn = S. MADAGASCARIENSIS
S. innocua Del. subsp. gerrardii (N.E. Br.) Verdoorn = S. MADAGASCARIENSIS
400 S. MADAGASCARIENSIS POIR.
(=S. innocua Del. subsp. dysophylla (Benth.) Verdoorn) 2
(=S. innocua Del. subsp. gerrardii (N.E. Br.) Verdoorn) 2

APOCYNACEAE Contributed by C.M. van Wyk 6549000

6680000 -ADENIUM ROEM. & SCHULT.
(=A. obesum (Forssk.) Roem. & Schult. var. multiflorum (Klotzsch) Codd) 2
A. obesum (Forssk.) Roem. & Schult. var. multiflorum (Klotzsch) Codd = A. MULTIFLORUM

6688000 -STROPHANTHUS DC.
2 BEENTJE. 1982. BELMONTIA 13: 17-163.

PERIPLOCACEAE Contributed by C.M. van Wyk 6729000

6740000 -CRYPTOLEPIS R. BR.
150 C. DELAGOENSIS SCHLTR.

6747000 -RAPHIONACME HARV. H.J.T Venter (BLF-U).
8. VENTER & VERHOEVEN. 1988. S. AFR. J. BOT. 54,6: 603-606.
9. VENTER & VERHOEVEN. 1988. S. AFR. J. BOT. 54,6: 607-610.
840 R. LOBULATA VENTER & VERHOEVEN
870 R. LUCENS VENTER & VERHOEVEN

ASCLEPIADACEAE Contributed by M. Jordaan and C.M. van Wyk 6752000

6787010 -PACHYCARPUS E. MEY.
3. SMITH. 1988. JL. S. AFR. BOT. 54,5: 399-439.
(=P. inconstans N.E. Br.) 3
(=P. validus (Schltr.) N.E. Br.) 3
400 P. CAMPANULATUS (HARV.) N.E. BR. VAR. SUTHERLANDII N.E. BR.
(=P. gerrardii (Harv.) N.E. Br.) 3
P. gerrardii (Harv.) N.E. Br. = P. CAMPANULATUS VAR. SUTHERLANDII
P. grandiflorus (L. f.) E. Mey. var. chrysanthus N.E. Br. = P. GRANDIFLORUS VAR. GRANDIFLORUS
P. grandiflorus (L. f.) E. Mey. var. elatocarinatus N.E. Br. = P. GRANDIFLORUS VAR. GRANDIFLORUS
(=P. grandiflorus (L. f.) E. Mey. var. chrysanthus N.E. Br.) 3
(=P. grandiflorus (L. f.) E. Mey. var. elatocarinatus N.E. Br.) 3
1400 P. GRANDIFLORUS (L. F.) E. MEY. VAR. TOMENTOSUS (SCHLTR.) N.E. BR.
P. inconstans N.E. Br. = P. ASPERIFOLIUS
P. insignis (Schltr.) N.E. Br. = P. TRANSVAALENSIS
2400 P. RIGIDUS E. MEY.
P. rigidus E. Mey. var. tridens E. Mey. = P. RIGIDUS
2900 P. STENOGLOSSUS (E. MEY.) N.E. BR.
3000 P. TRANSVAALENSIS (SCHLTR.) N.E. BR.
(=P. insignis (Schltr.) N.E. Br.) 3
P. validus (Schltr.) N.E. Br. = P. ASPERIFOLIUS

6789000 -STENOSTELMA SCHLTR.
(Note change in genus number)

6791000 -ASCLEPIAS L. Revision: A. Nicholas (PRE).
5. HILLIARD & BURTT. 1986. NOTES R. BOT. GDN EDINB. 43,2: 192-193.
6. NICHOLAS. 1987. BOTHALIA 17,1: 17-23.
7. NICHOLAS. 1987. BOTHALIA 17,1: 29-43.
1150 A. COMPRESSIDENS (N.E. BR.) A. NICHOLAS
(=A. navicularis (E. Mey.) Schltr. var. compressidens N.E. Br.) 6
3350 A. GORDON-GRAYAE A. NICHOLAS
4400 A. NAVICULARIS (E. MEY.) SCHLTR.
A. navicularis (E. Mey.) Schltr. var. compressidens N.E. Br. = A. COMPRESSIDENS

6870000 -BRACHYSTELMA R. BR.
3. HILLIARD & BURTT. 1988. NOTES R. BOT. GDN EDINB. 45,1: 77.
4. BALKWILL & BALKWILL. 1988. JL S. AFR. BOT. 54,1: 60-62.
1775 B. DYERI K. BALKWILL & M.-J. BALKWILL

6874000 -CEROPEGIA L.
C. flanaganii (Schltr.) Huber var. alexandrina Huber = RIOCREUXIA ALEXANDRINA
C. flanaganii (Schltr.) Huber var. fallax Huber = RIOCREUXIA WOODII
C. flanaganii (Schltr.) Huber var. flanaganii = RIOCREUXIA FLANAGANII

6875000 -RIDCREUXIA DECNE.
2. DYER. 1983. CEROPECIA, BRACHYSTELMA & RIOCREUXIA IN S. APR. 233.
150 R. ALEXANDRINA (HUBER) R.A. DYER
(=Ceropegia flanaganii (Schltr.) Huber var. alexandrina Huber) 1, 2
(=R. flanaganii Schltr. subsp. alexandrina (Huber) R.A. Oyer) 2
250 R. BURCHELLII K. SCHUM.
(=R. flanaganii Schltr. subsp. segregata R.A. Dyer) 2
R. flanaganii Schltr. subsp. alexandrina (Huber) R.A. Dyer = R. ALEXANDRINA
320 R. PLANAGANII SCHLTR.
R. flanaganii Schltr. subsp. segregata R.A. Oyer = R. BURCHELLII
R. flanaganii Schltr. subsp. woodii (N.E. Br.) R.A. Dyer = R. WODDII
700 R. WDDDII N.E. BR.
(=Ceropegia flanaganii (Schltr.) Huber var. fallax Huber) 1, 2
(=R. flanaganii Schltr. subsp. woodii (N.E. Br.) R.A. Dyer) 2

6885070 -DRBEDPSIS LEACH Revision: L.C. Leach (NBG).
200 D. CAUDATA (N.E. BR.) LEACH SUBSP. RHDDESIACA (LEACH) LEACH

6885100 -TRDMDTRICHE HAW. Revision: L.C. Leach (N8C).
2. LEACH. 1984. JL. S. APR. BDT. 50,4: 549-562.

BDRAGINACEAE Contributed by W.G. Welman 7038000

7043000 -EHRETIA P. BR.
1. BAKER & WRIGHT. 1905. PTA 4,2: 25.
2. PRIEDRICH-HDLZHAMMER. 1967. PSWA 119: 2-3.
100 E. AMDENA KLDTZSCH
E. hottentotica Burch. = E. RICIDA
150 E. OBTUSIPOLIA HOCHST. EX DC.
200 E. RIGIDA (THUNB.) DRUCE
(=Capraria rigida Thunb.) 2
(=E. hottentotica Burch.) 2

VERBENACEAE Contributed by W.G. Welman 7138000

7192000 -HDLMSKIDLDIA RETZ.
H. speciosa Hutch. & Corbishley = KARDMIA SPECIOSA
H. tettensis auctt. non (Klotzsch) Vatke = KARDMIA SPECIDSA

7192010 -KARDMIA P. DDP
1. FERNANOES. 1985. CARCIA DE DRTA 7(1-2): 33-46.
100 K. SPECIOSA (HUTCH. & CORBISHLEY) R. PERNANDES
(=Holmskioldia speciosa Hutch. & Corbishley) 1
(=Holmskioldia tettensis auctt. non (Klotzsch) Vatke) 1

LAMIACEAE Contributed by W.G. Welman 7210000

7359000 -SYNCDLDSTEMDN E. MEY. EX BENTH.
2. CDDD. 1988. BOTHALIA 18,1: 92-93.
875 S. RAMULOSUS E. MEY. EX BENTH.

7366000 -OCIMUM L.
O. fissilabrum Briq. = BECIUM FILAMENTOSUM
O. knyanum Vatke = BECIUM FILAMENTOSUM
O. rautanenii Briq. = BECIUM PILAMENTOSUM
O. stenoglossum Briq. = BECIUM FILAMENTOSUM

7366010 -BECIUM LINOL.
2. SEBALO. 1988. STUTTGARTER BEITR. NATURK. SER. A, 419: 51.
250 B. PILAMENTOSUM (PORSSK.) CHIOV.
(=B. knyanum (Vatke) N.E. Br. ex Broun & Massey) 2
(=B. obovatum (E. Mey. ex Benth.) N.E. Br. var. knyanum (Vatke) Cufod.) 1, 2
(=Dcimum fissilabrum Briq.) 1, 2
(=Ocimum knyanum Vatke) 1, 2
(=Ocimum rautanenii Briq.) 1, 2
(=Ocimum stenoglossum Briq.) 1, 2
B. knyanum (Vatke) N.E. Br. ex Broun & Massey = B. PILAMENTOSUM
B. obovatum (E. Mey. ex Benth.) N.E. 8r. var. knyanum (Vatke) Cufod. = B. PILAMENTOSUM

SCROPHULARIACEAE (PART A) Contributed by W.G. Welman 7460000

7471000 -DIASCIA LINK & OTTO Revision: O.M. Hilliard & B.L. Burtt (E); K. Steiner (NBC)
6. HILLIARD & BURTT. 1988. NOTES R. BOT. CDN EDINB. 45,1: 87-88.
3750 D. TRANSKEIANA HILLIARD & BURTT

7472000 -HEMIMERIS L. P.
1. HIERN. 1904. PC 4,2: 164.
2. DIELS. 1910. BOT. JB. 44: 121.
3. GRANT. 1938. ANN. MISS. BOT. CARD. 25: 435-453.
100 H. CENTRODES HIERN
(=H. nana Diels) 3
H. elegans Hiern = DIASCIA CAPSULARIS
200 H. CRACILIS SCHLTR.
H. macrophylla Thunb. = DIASCIA MACRDPHYLLA
300 H. MDNTANA L. P.
(=H. pachyceras Oiels) 3
(=H. racemosa (Houtt.) Merrill) 3
H. nana Diels = H. CENTRDDES
H. pachyceras Diels = H. MDNTANA
H. racemosa (Houtt.) Merrill = H. MDNTANA
400 H. SABULOSA L. P.
H. unilabiata Thunb. = DIASCIA UNILABIATA

752100D -PHYLLOPODIUM BENTH.
4. HILLIARD. 1989. NDTES R. BOT. GDN EDINB. 45,3: 481-491.
60 P. ANDMALUM HILLIARD
(=Polycarena plantaginea auct.) 4
83 P. CAESPITDSUM HILLIARD
P. calvum Hiern = MELANDSPERMUM TRANSVAALENSE
88 P. COLLINUM (HIERN) HILLIARD
(=Polycarena collina Hiern) 4
(=Polycarena pubescens Benth. p.p.) 4
96 P. DDLOMITICUM HILLIARD
97 P. ELEGANS (CHDISY) HILLIARO
(=P. linearifolium H. Bol.) 4
(=Polycarena linearifolia (H. Bol.) Levyns) 4
(=Selago elegans Choisy) 4
P. glutinosum Schltr. = TRIEENEA GLUTINDSA
P. krebsianum Benth. = GLEKIA KREBSIANA
P. linearifolium H. Bol. = P. ELEGANS
105 P. LUPULIFDRME (THELL.) HILLIARD
(=Polycarena lupuliformis Thell.) 4
110 P. MAXII (HIERN) HILLIARD
(=Polycarena maxii Hiern) 4
112 P. MICRANTHUM (SCHLTR.) HILLIARD
(=Polycarena rariflora Benth. var. micrantha Schltr.) 4
113 P. MIMETES HILLIARD
115 P. NAMAENSE (THELL.) HILLIARD
(=Polycarena namaensis Thell.) 4
117 P. PUBIPLDRUM HILLIARD
P. rupestre Hiern = MELANDSPERMUM RUPESTRE
2D3 P. RUSTII (RDLFE) HILLIARD
(=Selago rustii Rolfe) 4
P. schlechteri Hiern = TRIEENEA SCHLECHTERI
210 P. TWEEDENSE HILLIARD
220 P. VISCIDISSIMUM HILLIARO

7521010 -GLEKIA HILLIARD
1. HILLIARD. 1989. NDTES R. BDT. GDN EDINB. 45,3: 481-491.
100 G. KREBSIANA (BENTH.) HILLIARD
(=Phyllopodium krebsianum Benth.) 1

7522000 -POLYCARENA BENTH.
4. HILLIARD. 1989. NDTES R. BOT. CDN EDINB. 45,3: 481-491.
50 P. AEMULANS HILLIARD
350 P. BATTENIANA HILLIARD
P. calva (Hiern) Levyns = MELANDSPERMUM TRANSVAALENSE
P. collina Hiern = PHYLLDPDDIUM CDLLINUM
1050 P. CDMPTDNII HILLIARD
P. discolor Schinz = MELANDSPERMUM FDLIDSUM
1350 P. EXICUA HILLIARD
P. foliosa Benth. = MELANOSPERMUM POLIDSUM
1550 P. PDRMDSA HILLIARD
P. glutinosa (Schltr.) Levyns = TRIEENEA GLUTINDSA
1775 P. GRACILIS HILLIARD
1930 P. LILACINA HILLIARD VAR. LILACINA
1935 P. LILACINA HILLIARD VAR. DIPPICILIS HILLIARD
P. linearifolia (H. 8ol.) Levyns = PHYLLOPODIUM ELEGANS
P. lupuliformis Thell. = PHYLLOPODIUM LUPULIFORME
P. maxii Hiern = PHYLLOPODIUM MAXII
P. namaensis Thell. = PHYLLOPODIUM NAMAENSE
2350 P. NARDOUWENSIS HILLIARO
P. plantaginea auct. = PHYLLOPODIUM ANOMALUM
P. pubescens Benth. p.p. = PHYLLOPODIUM COLLINUM
P. rariflora Benth. var. micrantha Schltr. = PHYLLOPODIUM MICRANTHUM
P. rupestris (Hiern) Levyns = MELANOSPERMUM RUPESTRE
P. schlechteri (Hiern) Levyns = TRIEENEA SCHLECHTERI
3175 P. SUBTILIS HILLIARD
P. transvaalensis Hiern = MELANOSPERMUM TRANSVAALENSE

7522010 -MELANOSPERMUM HILLIARD
1. HILLIARD. 1989. NOTES R. BOT. GDN EDINB. 45,3: 481-491.
100 M. PDLIOSUM (BENTH.) HILLIARD
(=Polycarena discolor Schinz) 1
(=Polycarena foliosa Benth.) 1
200 M. ITALAE HILLIARD
300 M. RUDOLFII HILLIARD
400 M. RUPESTRE (HIERN) HILLIARO
(=Phyllopodium rupestre Hiern) 1
(=Polycarena rupestris (Hiern) Levyns) 1
500 M. SWAZICUM HILLIARD
600 M. TRANSVAALENSE (HIERN) HILLIARO
(=Phyllopodium calvum Hiern) 1
(=Polycarena calva (Hiern) Levyns) 1
(=Polycarena transvaalensis Hiern) 1

7522020 -TRIEENEA HILLIARD
1. HILLIARD. 1989. NOTES R. BOT. GDN EDINB. 45,3: 481-491.
100 T. ELSIAE HILLIARD
200 T. PRIGIDA HILLIARD
300 T. GLUTINOSA (SCHLTR.) HILLIARD

(=Phyllopodium glutinosum Schltr.) 1
(=Polycarena glutinosa (Schltr.) Levyns) 1
400 T. LANCILOBA HILLIARD
500 T. LASIOCEPHALA HILLIARD
600 T. LAXIFLORA HILLIARD
700 T. LONGIPEDICELLATA HILLIARD
800 T. SCHLECHTERI (HIERN) HILLIARD
(=Phyllopodium schlechteri Hiern) 1
(=Polycarena schlechteri (Hiern) Levyns) 1
900 T. TAYLORII HILLIARD

7562000 -LINDERNIA ALLIONI
5. PHILCOX. 1987. BOL. SOC. BROT. 60: 267-270.
50 L. CONFERTA (HIERN) PHILCOX
(=Ilysanthes conferta Hiern) 5
600 L. PULCHELLA (SKAN) PHILCOX
(=Ilysanthes pulchella Skan) 5
700 L. WILMSII (ENGL. & DIELS) PHILCOX
(=Ilysanthes muddii Hiern) 5
(=Ilysanthes wilmsii Engl. & Diels) 5

7564000 -ILYSANTHES RAF.
I. conferta Hiern = LINDERNIA CONFERTA
I. muddii Hiern = LINDERNIA WILMSII
I. pulchella Skan = LINDERNIA PULCHELLA
I. wilmsii Engl. & Diels = LINDERNIA WILMSII

SELAGINACEAE Contributed by W.G. Welman 7566000

7568000 -SELAGO L.
S. elegans Choisy = PHYLLOPODIUM ELEGANS
S. rustii Rolfe = PHYLLOPODIUM RUSTII

7569000 -MICRODON CHOISY
1. ROLFE. 1901. FC 5,1: 175-177.
2. LEVYNS. 1948. JL S. AFR. BOT. 14: 85.
100 M. CAPITATUS (BERG.) LEVYNS
(=M. ovatus (L.) Choisy) 2
(=Selago capitata Berg.) 2
150 M. CYLINDRICUS E. MEY.
(=Selago spicata Link) 1
300 M. LINEARIS CHOISY
350 M. LUCIDUS (VENT.) CHOISY
(=Selago lucida Vent.) 1
500 M. ORBICULARIS CHOISY
M. ovatus (L.) Choisy = M. CAPITATUS

SCROPHULARIACEAE (PART B) Contributed by W.G. Welman 7572000

7604000 -Gerardia L. = CYCNIUM
C. tubulosa L. f. = CYCNIUM TUBULOSUM SUBSP. TUBULOSUM

7616000 -SOPUBIA BUCH.-HAM. EX D. DON
S. fastigiata Hiern = S. KARAGUENSIS VAR. KARAGUENSIS
200 S. KARAGUENSIS OLIV. VAR. KARAGUENSIS
(=S. fastigiata Hiern) 2

7623000 -CYCNIUM BENTH. EMEND. ENGL.
3. HANSEN. 1978. DANSK BOT. ARKIV 32,3: 1-72.
100 C. ADONENSE E. MEY. EX BENTH. SUBSP. ADONENSE
350 C. TUBULOSUM (L. F.) ENGL. SUBSP. TUBULOSUM

ACANTHACEAE Contributed by W.G. Welman 7906000

8007000 -ASYSTASIA BLUME
A. natalensis C.B. Cl. = SALPINCTIUM NATALENSE
A. stenosiphon C.B. Cl. = SALPINCTIUM STENOSIPHON

8007010 -SALPINCTIUM T.J. EDWARDS
1. EDWARDS & GETLIFFE NORRIS. 1989. S. AFR. J. BOT. 55,1: 6-10.
100 S. HIRSUTUM T.J. EDWARDS
200 S. NATALENSE (C.B. CL.) T.J. EDWARDS
(=Asystasia natalensis C.B. Cl.) 1
300 S. STENOSIPHON (C.B. CL.) T.J. EDWARDS
(=Asystasia stenosiphon C.B. Cl.) 1

RUBIACEAE Contributed by W.G. Welman 8119000

8471000 -OLDENLANDIA GRONOV. EX L.
2. HILLIARD & BURTT. 1988. NOTES R. BOT. GDN EDINB. 45,1: 86.

ASTERACEAE Contributed by W.G. Welman 8729000

8734000 -ETHULIA L. F.
1. GILBERT & JEFFREY. 1988. KEW BULL. 43,2: 165-193.
100 E. CONYZOIDES L. F. SUBSP. CONYZOIDES
150 E. CONYZOIDES L. F. SUBSP. KRAUSSII (WALP.) M. GILBERT & C. JEFFREY
(=E. kraussii Walp.) 1
E. kraussii Walp. = E. CONYZOIDES SUBSP. KRAUSSII

8751000 -VERNONIA SCHREB.
13. JEFFREY. 1988. KEW BULL. 43,2: 195-277.
14. POPE. 1988. KEW BULL. 43,2: 279-289.
15. ANDERBERG. 1986. CLADISTICS 2,2: 158-186.
100 V. ADOENSIS SCH. BIP. EX WALP. VAR. KOTSCHYANA (SCH. BIP. EX WALP.) G.V. POPE
(=V. leptolepis Bak.) 14
(=V. woodii O. Hoffm.) 14
V. ampla O. Hoffm. = V. MYRIANTHA
625 V. ANTHELMINTICA (L.) WILLD.
(=V. stenolepis Oliv.) 13
1000 V. CINEREA (L.) LESS. VAR. CINEREA
(=Conyza cinerea L.) 13
1100 V. COLORATA (WILLD.) DRAKE SUBSP. COLORATA
1550 V. GALPINII KLATT
(=Pegolettia tenella DC.) 15
1800 V. GLABRA (STEETZ) VATKE VAR. GLABRA
(=Linzia glabra Steetz var. glabra) 8
1850 V. GLABRA (STEETZ) VATKE VAR. LAXA (STEETZ) BRENAN
(=Linzia glabra Steetz var. laxa Steetz) 13
2050 V. INHACENSIS G.V. POPE
V. kraussii Sch. Bip. ex Walp. = V. OLIGOCEPHALA
V. leptolepis Bak. = V. ADOENSIS VAR. KOTSCHYANA
2100 V. MEIOSTEPHANA C. JEFFREY
2300 V. MYRIANTHA HOOK. F.
(=V. ampla O. Hoffm.) 13
(=V. podocoma Sch. Bip. ex Vatke) 13
(=V. stipulacea Klatt) 13
2400 V. NATALENSIS SCH. BIP. EX WALP.
2500 V. NESTOR S. MOORE
3000 V. OLIGOCEPHALA (DC.) SCH. BIP. EX WALP.
(=V. kraussii Sch. Bip. ex Walp.) 13
V. podocoma Sch. Bip. ex Vatke = V. MYRIANTHA
V. stenolepis Oliv. = V. ANTHELMINTICA
V. stipulacea Klatt = V. MYRIANTHA
V. woodii O. Hoffm. = V. ADOENSIS VAR. KOTSCHYANA

8751030 -Linzia Sch. Bip. = VERNONIA
L. glabra Steetz var. glabra = VERNONIA GLABRA VAR. GLABRA
L. glabra Steetz var. laxa Steetz = VERNONIA GLABRA VAR. LAXA

8785000 -ADENOSTEMMA J.R. & G. FORST.
2. KING & ROBINSON. 1987. MONOGRAPHS SYST. BOT. 22: 477.
A. dregei DC. = A. VISCOSUM
A. natalense DC. = A. VISCOSUM
A. perrottetii DC. = A. VISCOSUM
300 A. VISCOSUM J.R. FORST. & G. FORST.
(=A. dregei DC.) 2
(=A. natalense DC.) 2
(=A. perrottetii DC.) 2

8816000 -Eupatorium L. = AGERATINA, CAMPULOCLINIUM, CHROMOLAENA, PEGOLETTIA, PTERONIA, STOMATANTHES
E. macrocephalum Less. = CAMPULOCLINIUM MACROCEPHALUM
E. rugosum Houtt. = AGERATINA ALTISSIMA

8816030 -AGERATINA SPACH
150 A. ALTISSIMA (L.) R.M. KING & H. ROBINSON *
(=Eupatorium rugosum Houtt.) 1

8816040 -CAMPULOCLINIUM DC.
1. KING & ROBINSON. 1987. MONOGRAPHS SYST. BOT. 22: 519.
100 C. MACROCEPHALUM (LESS.) DC. *
(=Eupatorium macrocephalum Less.) 1

8926000 -CONYZA LESS.
C. cinerea L. = VERNONIA CINEREA VAR. CINEREA

8998000 -ANAXETON GAERTN.
2. NORDENSTAM. 1988. S. AFR. J. BOT. 54,6: 631-632.
850 A. LUNDGRENII B. NORD.

9065000 -Iphiona Cass. Southern African species moved to ANISOTHRIX, ANTIPHIONA, PEGOLETTIA
I. dentata (H. Bol.) H. Bol. = ANISOTHRIX KUNTZEI
I. integra Compton = ANISOTHRIX INTEGRA

9072000 -ANISOTHRIX O. HOFFM.
1. ANDERBERG. 1988. BOT. JAHRB. SYST. 109,3: 363-372.
50 A. INTEGRA (COMPTON) A. ANDERB.
(=Iphiona integra Compton) 1
100 A. KUNTZEI O. HOFFM.
(=Iphiona dentata (H. Bol.) H. Bol.) 1
(=Pegolettia dentata H. Bol.) 1

9073000 -PEGOLETTIA CASS.
1. ANDERBERG. 1986. CLADISTICS 2,2: 158-186.
P. acuminata DC. = P. RETROFRACTA
P. dentata H. Bol. = ANISOTHRIX KUNTZEI
700 P. RETROFRACTA (THUNB.) KIES
(=P. acuminata DC.) 1
P. tenella DC. = VERNONIA GALPINII

9339000 -MATRICARIA L.
M. acutiloba (DC.) Harv. = MYXOPAPPUS ACUTILOBUS
M. africana Berg. = ONCOSIPHON AFRICANUM
M. albida (DC.) Fenzl ex Harv. = FOVEOLINA ALBIDA
M. capensis L. = ONCOSIPHON AFRICANUM
M. dichotoma (DC.) Fenzl ex Harv. = FOVEOLINA DICHOTOMA
M. glabrata DC. = ONCOSIPHON GLABRATUM
M. globifera (Thunb.) Fenzl ex Harv. = ONCOSIPHON PILULIFERUM
M. grandiflora (Thunb.) Fenzl ex Harv. = ONCOSIPHON GRANDIFLORUM
M. hirsutifolia S. Moore = FOVEOLINA ALBIDA
M. hirta (Thunb.) DC. = ONCOSIPHON AFRICANUM
M. pilulifera (L.f.) Druce = ONCOSIPHON

PILULIFERUM
M. sabulosa Wolley-Dod = ONCOSIPHON SABULOSUM
M. schinziana Thell. = FOVEOLINA SCHINZIANA
M. schlechteri H. Bol. ex Schltr. = ONCOSIPHON SCHLECHTERI
M. tenella DC. = FOVEOLINA TENELLA

9341070 -Tanacetum Harv. = ATHANASIA, COTULA, FOVEOLINA, HIPPIA, MYXOPAPPUS, PENTZIA, ONCOSIPHON, SCHISTOSTEPHIUM
T. acutilobum DC. = MYXOPAPPUS ACUTILOBUS
T. albidum DC. = FOVEOLINA ALBIDA
T. grandiflorum Thunb. = ONCOSIPHON GRANDIFLORUM
T. suffruticosum L. = ONCOSIPHON SUFFRUTICOSUM

9351000 -COTULA L.
C. globifera Thunb. = ONCOSIPHON PILULIFERUM
C. pilulifera L. f. = ONCOSIPHON PILULIFERUM
C. tanacetifolia L. = ONCOSIPHON SUFFRUTICOSUM

9366000 -PENTZIA THUNB. Revision: K. Bremer & S. Kallersjo (S)
9. KALLERSJO. 1988. BOT. J. LINN. SOC. 96: 299-322.
P. acutiloba (DC.) Hutch. = MYXOPAPPUS ACUTILOBUS
P. albida (DC.) Hutch. = FOVEOLINA ALBIDA
P. annua DC. = FOVEOLINA ALBIDA
P. dichotoma DC. = FOVEOLINA DICHOTOMA
P. eenii S. Moore = RENNERA EENII
P. galpinii Hutch. = MYXOPAPPUS HEREROENSIS
P. globifera (Thunb.) Hutch. = ONCOSIPHON PILULIFERUM
P. grandiflora (Thunb.) Hutch. = ONCOSIPHON GRANDIFLORUM
P. hereroensis O. Hoffm. = MYXOPAPPUS HEREROENSIS
P. intermedia Hutch. = ONCOSIPHON INTERMEDIUM
1825 P. LANATA HUTCH.
P. laxa Brem. & Oberm. = RENNERA LAXA
P. membranacea Hutch. = FOVEOLINA ALBIDIFORMIS
P. pilulifera (L. f.) Fourc. = ONCOSIPHON PILULIFERUM
P. sabulosa (Wolley-Dod) Hutch. = ONCOSIPHON SABULOSUM
P. schinziana (Thell.) Merxm. & Eberle = FOVEOLINA SCHINZIANA
P. suffruticosa (L.) Hutch. ex Merxm. = ONCOSIPHON SUFFRUTICOSUM
P. tanacetifolia (L.) Hutch. = ONCOSIPHON SUFFRUTICOSUM

9366010 -RENNERA MERXM.
1. KALLERSJO. 1988. BOT. J. LINN. SOC. 96: 299-322.
25 R. EENII (S. MOORE) KALLERSJO
(=Pentzia eenii S. Moore) 1
50 R. LAXA (BREM. & OBERM.) KALLERSJO
(=Pentzia laxa Brem & Oberm.) 1
100 R. LIMNOPHILA MERXM.

9366020 -ONCOSIPHON KALLERSJO
1. KALLERSJO. 1988. BOT. J. LINN. SOC. 96: 299-322.
100 O. AFRICANUM (BERG.) KALLERSJO
(=Matricaria africana Berg.) 1
(=Matricaria capensis L.) 1
(=Matricaria hirta (Thunb.) DC.) 1
200 O. GLABRATUM (THUNB.) KALLERSJO
(=Matricaria glabrata (Thunb.) DC.) 1
300 O. GRANDIFLORUM (THUNB.) KALLERSJO
(=Matricaria grandiflora (Thunb.) Fenzl ex Harv.) 1
(=Pentzia grandiflora (Thunb.) Hutch.) 1
(=Tanacetum grandiflorum Thunb.) 1
400 O. INTERMEDIUM (HUTCH.) KALLERSJO
(=Pentzia intermedia Hutch.) 1
500 O. PILULIFERUM (L. F.) KALLERSJO
(=Cotula globifera Thunb.) 1
(=Cotula pilulifera L. f.) 1
(=Matricaria globifera (Thunb.) Fenzl ex Harv.) 1
(=Matricaria pilulifera (L. f.) Druce) 1
(=Pentzia globifera (Thunb.) Hutch.) 1
(=Pentzia pilulifera (L. f.) Fourc.) 1
600 O. SABULOSUM (WOLLEY DOD) KALLERSJO
(=Matricaria sabulosa Wolley Dod) 1
(=Pentzia sabulosa (Wolley Dod) Hutch.) 1
700 O. SCHLECHTERI (H. BOL.) KALLERSJO
(=Matricaria schlechteri H. Bol. ex Schltr.) 1
800 O. SUFFRUTICOSUM (L.) KALLERSJO
(=Cotula tanacetifolia L.) 1
(=Pentzia suffruticosa (L.) Hutch. ex Merxm.) 1
(=Pentzia tanacetifolia (L.) Hutch.) 1
(=Tanacetum suffruticosum L.) 1

9366030 -MYXOPAPPUS KALLERSJO
1. KALLERSJO. 1988. BOT. J. LINN. SOC. 96: 299-322.
100 M. ACUTILOBUS (DC.) KALLERSJO
(=Matricaria acutiloba (DC.) Harv.) 1
(=Pentzia acutiloba (DC.) Hutch.) 1
(=Tanacetum acutilobum DC.) 1
200 M. HEREROENSIS (O. HOFFM.) KALLERSJO
(=Pentzia galpinii Hutch.) 1
(=Pentzia hereroensis O. Hoffm.) 1

9366040 -FOVEOLINA KALLERSJO
1. KALLERSJO. 1988. BOT. J. LINN. SOC. 96: 299-322.
100 F. ALBIDA (DC.) KALLERSJO
(=Matricaria albida (DC.) Fenzl ex Harv.) 1
(=Matricaria hirsutifolia S. Moore) 1
(=Pentzia albida (DC.) Hutch.) 1
(=Pentzia annua DC.) 1
(=Tanacetum albidum DC.) 1
200 F. ALBIDIFORMIS (THELL.) KALLERSJO
(=Matricaria albidiformis Thell.) 1
(=Pentzia membranacea Hutch.) 1
300 F. DICHOTOMA (DC.) KALLERSJO
(=Matricaria dichotoma (DC.) Fenzl ex Harv.) 1
(=Pentzia dichotoma DC.) 1
400 F. SCHINZIANA (THELL.) KALLERSJO
(=Matricaria schinziana Thell.) 1
(=Pentzia schinziana (Thell.) Merxm. & Eberle) 1
500 F. TENELLA (DC.) KALLERSJO
(=Matricaria tenella DC.) 1

9406000 -CINERARIA L.
10. HILLIARD. 1989. NOTES R. BOT. GDN EDINB. 45,2: 185-187.
125 C. ALBOMONTANA HILLIARD
3275 C. VACANS HILLIARD

9420000 -OTHONNA L. Revision: B. Nordenstam (S)
5925 O. OVALIFOLIA HUTCH.

9438000 -BERKHEYA EHRH. Revision: S. Roessler (M)
7. HILLIARD. 1989. NOTES R. BOT. GDN EDINB. 45,2: 183-185.
4925 B. LEUCAUCETA HILLIARD

9500000 -OLDENBURGIA LESS.
1. BONO. 1987. S. AFR. J. BOT. 53,6: 493-500.
O. arbuscula DC. = O. GRANDIS
150 O. GRANDIS (THUNB.) BAILL.
(=Arnica grandis Thunb.) 1
(=O. arbuscula DC.) 1
175 O. INTERMEDIA BONO
200 O. PAPIONUM DC.
300 O. PARADOXA LESS.

Each contributor is acknowledged at the beginning of the groups for which he/she is responsible. Although staff of the Botanical Research Institute have final responsibility for maintaining Taxon-PRECIS, we acknowledge with gratitude the co-operation of other botanists in reporting changes. Mrs J. Mulvenna spent hours slaving over a hot terminal to add all the changes to PRECIS, thereby also helping immeasurably in catching and eliminating inconsistencies.

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ANNUAL REPORT OF THE BOTANICAL RESEARCH INSTITUTE 1988/1989

1st April 1988–31st March 1989

CONTENTS

INTRODUCTION

It can be reported with satisfaction that the threat of total dismemberment of the Botanical Research Institute, which would have been the result of the implementation of the Commission for Administration's Report of February 1988, has been averted. The efforts needed to forestall what would have been a disastrous event for botany in South Africa have taken an inescapable toll of day to day activities and the delays in the process of the amalgamation of the Botanical Research Institute and the National Botanic Gardens, in addition, have had a strongly negative influence on staff morale.

It is regretted that the BRI has had to sacrifice eight posts to the newly established Pasture Research Centre of the Department of Agriculture and Water Supply, but it is gratifying that the relinquishing of these posts was not accompanied by the loss of any of the botanical functions for which the BRI is responsible. The botanical mandate of the BRI has therefore been transferred to the new organization, as a whole. The new national botanical organization will produce major benefits for all concerned, if managed efficiently and in the national interest. In this context it is important to emphasize that the new organization will have a wider scope than the BRI, including not only research but also relevant aspects of horticulture and conservation. In addition, the education of the public towards the realization of their responsibility and role in maintaining a stable plant environment, has an equal priority. The object of the new organization will therefore be to function as the primary promoter of botanical extension, research and services in the State Sector. This implies that its development programmes will have to be geared towards satisfying the primary needs of the state in the fields mentioned.

The research output of the Institute, in spite of the generally unsettling effect of the amalgamation, remained at a high level, the total of publications by staff being 85 papers of different kinds.

The journals published by the Institute appeared on schedule. The fiftieth volume of *The Flowering Plants of Africa* underwent a facelift and appeared with an attractive illustrated cover and now includes an editorial. Two parts of *Bothalia*, the house journal of the Institute, were published. In the *Flora of southern Africa* the appearance of the monographic account of the legume genus *Aspalathus* (Papilionoideae) by the late Rolf Dahlgren set a standard unlikely to be easily surpassed.

The third edition of Acocks's *Veld Types of South Africa* appeared during the year and contains a new selection of veld photographs of higher quality. This re-issue, like its forerunners, should prove to be a popular addition to our publications.

Computers are playing an increasing role in the organization. The use of DELTA, the international computerized system of preparing manuscripts on taxonomic subjects, is gaining momentum in the Institute and is likely to revolutionize the process of writing of flora handbooks. The procurement of this system for the BRI again places it ahead of many other organizations. Generated by the computerized PRECIS data system a list of nearly 750 new names and name changes has appeared in the journal *Bothalia*. This annual contribution, compiled from information gathered in scanning over 120 journals, updates the *List of species of southern African plants* (edn 2) announced in the 1987/88 Annual Report, thus extending the usefulness of this standard work. Keeping abreast of name changes remains a problem of considerable magnitude, which is made manageable by the unique service provided to users by the BRI.

The response to the demonstration of the computerization of the curatorial and service functions of the National Herbarium, at the AETFAT Congress in Hamburg in 1988, showed that in this respect also, the Institute has maintained its leading position. The establishment of a database on indigenous southern African food plants promoted during the AETFAT Congress, was also favourably received.

Two major plans to improve accommodation for staff and to ensure the safety of the collections were finalized during the year under review. Firstly the installation of an air-conditioning and a gas-flooding system to protect the irreplaceable collections of the National Herbarium against fire was successfully completed. In addition, the expansion of accommodation in the basement of the main building in Pretoria, by enclosing the areas under the western wing, was completed and greatly improved the

facilities for decontaminating plant materials before these are brought into the building.

In general the Institute had a good year and it is to be hoped that the large number of new initiatives which are being developed will receive added stimulus once the unsettling effects of the process of amalgamation have abated. We look forward to a bright future.

HERBARIUM DIVISION

For the third successive year, under-staffing and a heavy workload have placed staff of the Institute's four herbaria under considerable pressure, affecting all major functions, namely, curation, research and herbarium services. This situation should improve considerably in the following year, with the introduction of a handling fee for plant identifications and through the selective control of accessions into the National Herbarium.

National Herbarium, Pretoria (PRE)

Curation

Scientific staff continued to scan over 120 scientific journals as well as books for taxonomic and nomenclatural changes covering the *Flora of southern Africa* region. These contained 172 articles of direct relevance to southern Africa. A total of 744 changes was recorded affecting about 3% of the flora. These included: 412 new names (of which about 293 were new taxa), 205 names reduced to synonymy and 44 orthographic corrections.

An extension of the known distribution area was recorded for 45 taxa, mostly in terms of provincial boundaries (Transvaal 1 new taxon, OFS 3, Natal 4, Cape 18, Transkei 5, Botswana 1 and Swaziland 3) with 10 new records for southern Africa.

Computerization

The in-house herbarium computer system is functioning well and continues to be an important aid, resulting in both improved efficiency and better management. New applications developed on the Burroughs B28 system include: merging outstanding specimen loan data with a standard loan expiry letter and the use of the computer to selectively control the accessioning of specimens into the National Herbarium.

Accommodation

The major disruptive changes that the National Herbarium and Mary Gunn Library underwent, with the installation of fire protection (halon flooding) and air conditioning, came to an end towards the middle of the year, much to the relief of all herbarium staff. This was followed immediately, however, by three further additions to the Herbarium, namely, the installation of three working bays on the south side of each herbarium wing, provision of a special room for decontaminating and drying specimens and a new SEM room and various other rooms adjacent to the Moss Herbarium. All these alterations are now complete and the herbarium is, at last, functioning normally again.

Visitors

In addition to numerous local visitors from various universities, Government institutes, nature conservation departments etc., together with members of the general public, the herbarium was also consulted by officers and personnel from Lesotho, Botswana, Swaziland, Bophuthatswana, Venda and Transkei.

A number of overseas botanists visited the Institute and Herbarium. These included: Prof. D. Wiens (Utah, USA); Dr C.L. Calvin (Oregon, USA); Miss S. Liede (Hamburg, W Germany); Prof. and Mrs D. & U. Müller-Doblies (Berlin, W Germany); Dr R.N. Lester (Birmingham, England); Prof. J.R. Harborne (Reading, England); Mr and Mrs la Croix (Darling, England); Dr F. Bauman (Amsterdam, Netherlands); Prof. R.M. Schuster (Massachusetts, USA); Dr S.P. Doolan (Oxford, England); Dr D.J. Lehmiller (Texas, USA); Dr M. Hale (Washington, USA); Miss S. Andrews (Kew, England); Dr P. Perrino (Italy); Dr C. Laghetti (Italy); Dr D.A. Preston (Indiana, USA).

Collecting expeditions

Due to financial and other constraints, few collecting expeditions were undertaken this year. Those that were undertaken included trips to Namaqualand (*Riccia* and general collecting); northern Natal and eastern Transvaal (*Vigna* and Polygonaceae); eastern OFS (general collecting) and SW Cape (*Pentameris*).

Herbarium services

Plant identifications numbering 211 batches and 13 229 specimens were undertaken for officers of this Institute, various state departments, provincial administrations, universities and neighbouring States. The major users of the service were: staff of the BRI 26% of the material identified; Universities 20%; nature conservation 16%; museums 16%; botanic gardens 10%; private collectors 5%; agriculture 3%; forestry 2% and others 2%. Identifications for 233 visitors numbered 1 152. Of the specimens received as gifts or part of exchange agreements 1 620 had to be given names or renamed. Seventy-one specimens were identified for Onderstepoort involving stock poisonings. Enquiries received by telephone totalled 978. New accessions to the herbarium numbered 22 886 for southern Africa and ± 6 166 for tropical Africa and other areas.

Specimen loans sent to local and overseas herbaria numbered 85 (comprising 11 046 specimens) with 101 existing loans returned in full and 31 loans returned in part (8 167 specimens were received back in total). The total number of outstanding loans is 308 (35 425 specimens).

Some 10 930 specimens were despatched as part of exchange agreements and 5 953 were received by PRE. Specimens received as gifts totalled 1 519 while 2 011 specimens were dispatched as gifts in return.

Research and related activities

Contributions to the lichen flora (F. Brusse). Six new species were described and ten new combinations made

in the genus *Parmelia*. Two new species were also described for *Moronea* and *Fuscidea*, one in each genus. Eight new lichen records were made for southern Africa.

Ricciaceae (Hepaticae) (S.M. Perold). Three papers were published during the year on: *Riccia nigrella* DC. and *R. campbelliana* Howe (both new records for southern Africa) and two new species *R. argenteolimbata* and *R. albornata*. Two papers are in press involving *R. montana* and *R. alboporosa* (new species) and *R. albolimbata* and the status of *R. albosquamata*. Four more papers have been submitted for publication. Final drafts of 30 *Riccia* species have been written up for the revision of the family. Five new species in the section *Pilifer* are still being investigated. Distribution maps for 35 species are now complete. The artwork for 32 species is also complete.

Contributions to the moss flora (J. van Rooy). The genera *Rhachithecium, Rhabdoweisia* and *Orthotrichum* have been completed for the 3rd fascicle of the flora. Three undescribed species and two new records for Africa have been identified in the family Orthotrichaceae. Work on the illustrations and distribution maps for this family is nearing completion. Work on the family Polytrichaceae for the 4th fascicle has commenced.

Revision of Carex *(Cyperaceae) (C. Reid)*. Seventeen taxa have been delineated. Two formerly described species cannot be upheld and one requires further investigation. One putative hybrid has been identified. All loan specimens have been identified and their qualitative and quantitative characters are currently being measured. Loans from three institutions are awaited. Typification is 75% complete with mainly the cosmopolitan taxa still outstanding.

Polygonaceae (G. Germishuizen). A revision of the genus *Oxygonum* has now finally been completed and written up in the *Flora of southern Africa* format. Work on the genera *Fagopyrum, Emex* and *Rumex* is still in progress.

Revision of Vigna *(Fabaceae) (B.J. Pienaar)*. This revision is now approaching completion. Thirteen species are recognised for which the descriptive work is largely complete.

Revision of Convolvulaceae (W.G. Welman). Ninety-one descriptions of the Convolvulaceae in Prof. A.D.J. Meeuse's manuscript were shortened to fit the *Flora of southern Africa* format.

Transvaal Wild Flowers (Vol. 2) (*G. Germishuizen*). Descriptions were completed for 60 species taking the total to 150. The artist, Mrs Anita Fabian, has completed illustrations for 350 taxa which means that this component of Volume 2 is 75% complete.

Flora of the Transvaal (*E. Retief and P. Herman*). This flora is to closely resemble, with some additions, the *The flora of Natal* by J.H. Ross (1972). To date, data sheets have been completed for 73 families, 182 genera and 861 taxa. This is 11,8% of the total number of taxa for the region.

Research support

Scanning electron microscope (S.M. Perold). Some 2 974 SEM micrographs were prepared for the following officers: Dr R. Ellis (grass leaf surfaces); Mr N. Barker (grass caryopses); Dr H. Glen (*Aloe* leaf surfaces); Mr J. van Rooy (moss leaves and capsules); Mrs S. Perold (*Riccia* thalli and spores); Mr G. Germishuizen (*Oxygonum*); Miss C. Reid (*Carex* caryopses); Mr F. Brusse (lichen thalli); Mr D. McDonald (*Pelargonium* pollen); Dr K.L. Immelman (*Justicia* pollen); Dr B. de Winter (*Gorteria*) and Miss E. Retief (*Cyphostemma* leaves). Towards the end of 1988 the SEM unit was moved to its new premises in the basement next to the Cryptogam Herbarium.

Expansion of collections from poorly represented areas (various contributors). North-western Cape—holdings for the sixteen $^1/_4$° grids visited, increased by 71% from 132 to 447 collections; eastern Transvaal—although most of the twenty-one $^1/_4$° grids visited were fairly well represented in PRE, two were not and increased by 43% from 74 to 126 collections.

Expansion of the fruit, seed and spirit collections (E. Retief and G. Germishuizen). The fruit and seed collections remained unchanged at 4 567 and 4 134 respectively. The spirit collection was expanded from 3 726 to 3 801 collections.

Publications

Seventeen articles appeared in local (15) as well as overseas (2) journals. A further 31 articles are in press awaiting publication.

Natal Herbarium, Durban (NH)

No staff changes occurred during the year. Miss R. Williams continued her good work as Curatrix of the Herbarium closely assisted by Mrs H.E. Noble and the rest of the herbarium staff.

Mr A.M. Ngwenya attended the 1988 International Diploma Course in Herbarium Techniques. This was a three month course which was held at the Royal Botanic Gardens, Kew (Figure 1).

A total of 3 101 specimens were identified, 412 visitors were attended to, 838 specimens were sent out on loan and accessions to the herbarium numbered 2 261.

One thousand and fifty-three Dicotyledon specimens from the Cape have been sent to the National Herbarium and 434 to the Stellenbosch Herbarium.

Albany Museum Herbarium, Grahamstown (GRA)

The post of Herbarium Assistant remained unfilled from November 1987 to October 1988 when Mrs Louise Verwy was appointed. During the eleven intervening months the herbarium staff, and in particular Mrs E. Brink, Curatrix of the herbarium, were under considerable pressure trying to deal with the workload due to the vacant post.

FIGURE 1.—Mr Alfred Ngwenya of the Natal Herbarium receives his International Diploma in Herbarium Techniques from Dr G.T. Prance, Director of the Royal Botanic Gardens, Kew, 4 November 1988.

Dr Amy Jacot Guillarmod is established in her part-time post as Curator of the Pocock Marine Algae. Mr Neil Abrahams, who has given voluntary assistance in the herbarium for the past 21 years, has become an integral part of the 'family' and is sorely missed whenever he leaves town for commitments elsewhere.

The location of this herbarium within a large Museum is one of the factors which gives a strong bias towards the public service performed by this Unit. It is also clear that Grahamstown's chief 'export', education, plays a role in the community's expectations of the Museum. Action was taken in August to limit the access of visitors to the herbarium, to give staff more time to perform curatorial tasks. Public access to the herbarium is now restricted to between 08h00 and 12h00 on week-days. Although visitors adapted quickly to this change, the actual number of visitors during the year increased slightly to 751.

Other information services also increased for the year with plant identifications numbering 2 440, telephone queries 600 and correspondence 238. Display in the herbarium totalled 39, many of these made possible by material brought in by members of the public. Material displayed in the Museum entrance decreased slightly to six, compared to nine displays last year.

Many of the identifications done were of plant fragments either for the State Veterinarian (seven visits) or the Museum's archaeologist (five visits).

The numbers of specimens mounted (1 507) and accessioned (2 279) differ very little from last year. A backlog, however, does exist that needs attention. Nine loans to other institutions were dealt with, four (393 sheets) were sent out and five (202) were refiled. The herbarium staff continued to assist Mrs G.D. Court who is busy with the Namaqualand Flora. Eighteen loans (2 616 sheets) were either received or returned on her behalf to other herbaria.

The Grahamstown Nature Reserve was visited 27 times during this year. The Nature Reserve Caretaker is just able to keep the alien infestation at its present level and, alone, is unable to really make any inroads into it. It is much to his credit that the Reserve still shows up clearly against the surrounding weed-infested slope as a protected area.

Government Herbarium, Stellenbosch (STE)

The herbarium remains in the temporary accommodation provided by the University in the old Carnegie Library. The renovations to the Natural Sciences building are progressing well and the herbarium should move back during the latter half of 1989.

During the year 2 496 specimens were identified for the staff, various government and provincial bodies, and for private firms and individuals. This is less than in previous years and has provided time for staff to do meaningful curatorial work and research. Telephone enquiries during the year numbered 211 with 272 visitors requiring information. Accessions to the herbarium were 2 240 specimens. The recording of identifications and listing of loans is now working well in a microcomputer-based system.

Mr Oliver continued his work on minor genera of the Ericaceae concentrating on an extremely variable complex of four genera with 65 species. He delivered a paper on his generic concepts in the capsular genera at a Heather Symposium held by the Linnean Society of London. Thereafter he worked on the collections at the Royal Botanic Gardens, Kew, and the British Museum. Mrs Beyers has begun work on the thymelaeaceous genera *Lachnaea* and *Cryptadenia*. Mrs Fellingham has been investigating some problem groups in the genus *Cliffortia* (Rosaceae).

Collecting trips were mainly confined to local ones in search of research material. However, Mrs Fellingham

spent four days collecting in an undercollected grid area near Sutherland.

FLORA RESEARCH DIVISION

Dr G.E. Gibbs Russell who has led this division since November 1984 is presently working as Database Co-ordinator of the Flora of North America project at the Missouri Botanical Garden. Dr O.A. Leistner has been temporarily put in charge of the division.

Flora of southern Africa (FSA)

With the aid of the computer-based Register of Southern African Plant Taxonomic Projects, research work of the co-operators and potential contributors to this huge project has been co-ordinated. Although the Department no longer finances research contracts on this project, taxonomists outside the Institute have continued to support the work. Minor purchases of art work and manuscripts could be made from the divisional budget. The seventh meeting of the *FSA* working group was held during the Congress of the South African Association of Botanists (SAAB) in Pretoria during January 1989. The Association was requested to support the creation of a fund to finance work undertaken for the *FSA*. News on the *FSA* was publicised in *Forum Botanicum*, the newsletter of the Association.

Vol. 16,3,6 of the *FSA* was published. It deals with the genus *Aspalathus* of the family Fabaceae and comprises 278 species, including *A. linearis* the Rooibos tea. The work written by the late Prof. Rolf Dahlgren of the University of Copenhagen, Denmark, is illustrated by 146 figures and 123 distribution maps.

Bryophyta: a total of 15 families, comprising 41 genera and 65 species, have been revised and written up in *FSA* format by Dr R.E. Magill of the Missouri Botanical Garden and Mr J. van Rooy. Five species have been illustrated by Miss G.C. Condy.

Vol. 2: Poaceae—Ehrharteae. Dr G.E. Gibbs Russell continued her revision of the genus *Ehrharta* in co-operation with Dr R.P. Ellis. The Dura group of this genus was published in *Bothalia*, the Ramosa group was submitted for publication and morphological data for the Capensis group were recorded in the DELTA system for computerizing plant descriptions.

The computerized manual for the grasses of southern Africa, designed as a precursor to Vol. 2 of the *FSA*, is nearing completion. Generic descriptions were drawn up by Dr G.E. Gibbs Russell from the data base of world grasses maintained at the Australian National University, Canberra. The other members of the group working on this manual are Mrs L. Fish, Dr H.M. Anderson, Miss M. Koekemoer, Mr N. Barker and Mrs W.J.G. Roux. Some 700 of the 970 taxa to be dealt with in the work have been written up and illustrations were completed for about 180 genera.

Vol. 5: Liliaceae—Aloinae. The manuscript of *Aloe* by Dr H.F. Glen and Mr D.S. Hardy has been edited and is almost ready for publication. The possibility of having this genus published by the private sector in a format going beyond that of the normal Flora volumes is being investigated. The manuscript of *Kniphofia* by Dr L.E. Codd has been edited but the material on *Gasteria* has been temporarily withdrawn by the author.

Liliaceae—Asparagoideae. Dr K.L. Immelman who took over the incomplete manuscript of *Protasparagus* from Mrs A.A. Mauve (Obermeyer) has nearly completed the work. She checked all specimens in the National Herbarium and drew up new distribution maps for all the accepted 69 species in the genus.

Vol. 8: Orchidaceae. Except for the revision of the genus *Disperis*, which is now being undertaken by Mr J. Manning, the manuscript of this family is complete and has been submitted to the editor.

Vol. 9: the manuscripts by Dr K.L. Immelman on the families Salicaceae, Fagaceae, Urticaceae and Piperaceae are awaiting publication, pending completion of work on Myricaceae and Moraceae.

Vol. 11: Mesembryanthemaceae. Dr H.E.K. Hartmann of the University of Hamburg, W Germany and her students have revised several more genera in the Leipoldtiinae including *Cephalophyllum* and *Pleiospilos*.

Vol. 12: Portulacaceae. Dr H.F. Glen and Mr D.S. Hardy have started on a revision of this family for the *FSA*. A prototype character list for use with DELTA was generated and tested using the data in H.R. Toelken's revision of *Talinum*. A list of names, types, literature sources and other useful information was drawn up.

Vol. 16: Fabaceae. Mr B.D. Schrire who is preparing an account of the tribe Indigoferae has drawn up a checklist of *Indigofera* comprising information on almost 300 taxa. A synopsis of the species of the genus is well advanced. Some 40 to 50 new taxa need to be described in the genus. About 140 name changes in *Indigofera* were entered into the update of Taxon-PRECIS.

Vol. 23: Lythraceae, Lecythidaceae and Rhizophoraceae. Except for one uncertain taxon, all taxonomic and nomenclatural decisions have been taken for the revision of the Lythraceae. The treatment of the one species of the Lecythidaceae has been completed. In Rhizophoraceae manuscripts of the three genera with a single species each in the region are largely complete. The fourth genus, *Cassipourea*, is considered to comprise four species and three subspecies.

Vol. 24: Prof. E.F. Hennessy at the University of Durban-Westville has continued her work on *Combretum* and Prof. A.E. van Wyk of the University of Pretoria his work on Myrtaceae and Melostomataceae.

Vol. 25: Ericaceae. Mr E.G.H. Oliver has concentrated on four of the 'minor genera' in the family and has sunk the southern African members of *Philippia* under *Erica*. This brings the number of species in this genus, the largest genus of flowering plants on the subcontinent, to about 660.

Vol. 26: Convolvulaceae: Miss W.G. Welman has adapted most of the work by Prof. A.D.J. Meeuse to *Flora*

format. Descriptions of ten species not included in Meeuse's revision of 1958 have also been completed.

Vol. 30: Pedaliaceae—Gesneriaceae. Prof. H.-D. Ihlenfeldt of the University of Hamburg, West Germany and his students have progressed with their work on Pedaliaceae, Martyniaceae and Orobanchaceae.

Vol. 30: Acanthaceae—Justiciae. The revision of the genus *Justicia* by Dr K.L. Immelman, for which she was awarded a Ph.D., has been adapted to *FSA* format and edited. This genus and the other large genus *Monechma* still await the completion of a few minor genera by researchers outside the Institute.

Vol. 33: Asteraceae—Inuleae. Miss M. Koekemoer has started on a revision of *Disparago*. A preliminary analysis has shown that ten taxa can be distinguished of which three are undescribed.

Pretoria Flora

Dr O.A. Leistner completed the family Asteraceae. The last group dealt with was group 8 comprising 36 species of *Helichrysum* and related genera. All families have now been written up. Some updating of existing manuscript remains to be done as well as completing the introductory chapter.

Namaqualand Flora

The contract awarded by the Department to Dr C. Boucher of the University of Stellenbosch to produce an identification manual for the flora of Namaqualand was renewed. After some initial technical problems good progress has been made with this project.

Palaeoflora of southern Africa

Dr J.M. Anderson and Dr H.M. Anderson have completed Vol. 2 dealing with the Gymnosperms (excluding *Dicroidium*) of the Molteno Formation and the work has gone to press. Camera-ready copy of 567 pages has been provided comprising 331 photographic plates (with a total of 3 386 individual photos), 1 107 line drawings, 154 tables and 117 maps. The work deals with 111 species belonging to 23 genera. Vol. 3, which will cover the lower plant groups, including ferns, is in preparation.

Liaison Officer, Kew

Mr B. Schrire ended his term of office and was succeeded by Mr A. Nicholas. They dealt with 178 queries and requests from both South Africa and overseas. Mr Schrire worked out the nomenclature of the estimated 300 species of *Indigofera* in southern Africa after a study tour of 15 European herbaria. He is writing up this large genus with the aid of the DELTA programme. The research work of Mr Nicholas was mainly focussed on the section *Trichocodon* of the asclepiadaceous genus *Pachycarpus*. He also delivered a seminar on the Asclepiadaceae to the School of Botany, Trinity College, Dublin. A selection of tree paintings from the Botanical Research Institute exhibited at a Royal Horticultural Society show in London won a Grenfell Silver-gilt medal.

DATA SUBDIVISION

The subdivision continued to co-ordinate the computer requirements of the Institute. The Institute's present computer systems include two large data storage systems on the B7900 mainframe of the Department of Agriculture (PRECIS and PHYTOTAB), SABINET links to IBM mainframe for the library, as well as numerous smaller PC systems, including a new IBM compatible PC for the vegetation ecology section, which replaces the old Hewlett Packard 9845B. The Herbarium mini system, a Unisys B26, is also linked via a modem to the B7900 mainframe.

PRECIS, at present under the jurisdiction of the Herbarium Division, is managed by Dr H.F. Glen and Mr N.P. Barker. PRECIS has continued to grow, with label information on approximately 18 000 specimens added over the past year. The present number of specimens catered for by the data base totals 661 000.

No fewer than 82 requests for information were received, the majority being from universities (25 requests). Other requests received came from 12 other government departments, nine individuals, eight other botanical gardens and five from overseas. There were also 23 requests from staff of the Institute and Units.

Taxon-PRECIS continues to be updated regularly with new and corrected names, the annual list of which appears in this edition of *Bothalia*. The maintenance of this information, a task co-ordinated by Mrs B.C. de Wet and Mrs J.M. Mulvenna, is assisted by the herbarium mini computer which has now been programmed to record all changes in the PRECIS format. This allows the easy updating of PRECIS. It is hoped that a similar system will be programmed in the near future, allowing the label information for specimen labels typed on the Herbarium mini system to be formatted and entered directly into PRECIS-compatible files.

Forty-eight data sets obtained from theses and journals are presently on the PHYTOTAB data base. Data files required for the synthesis of these matrices are being loaded by Mrs W. Jones. Mr R.H. Westfall and Mrs B.C. de Wet have refined (PHYTO 00—key construction) and developed (PHYTO 39—environmental analysis) programs for the data base.

Smaller systems continuing on the B7900 include the Garden Records system, developed by Mrs B.C. de Wet and maintained by Mrs K.P. Clarke, and the PHOTOS data base maintained by Miss A.P. Backer. The latter system holds information on photographic vegetation records for the Vegetation Ecology Division.

STRUCTURE AND FUNCTION DIVISION

Under the leadership of Dr J.J. Spies and in spite of limited manpower, this division has had a productive year. A total of thirteen articles were published in scientific journals and ten papers, as well as four poster papers, were read at congresses (of these, one paper and one poster were presented overseas). Mesdames H. du Plessis and E.J.L. Saayman shared the prize for the best poster at the Congress of the South African Genetic Society.

Cytogenetics

During August 1988 Dr J.J. Spies undertook a study tour to the USA and Canada where he read a paper and presented a poster at the XVIth International Genetic Congress in Toronto. A visit to Dr G. Davidse (Missouri Botanical Garden, St Louis, Missouri) made it possible to complete an article on the genus *Ehrharta* and to make good progress with two other articles. This co-operation is the result of Dr Davidse's visit as research associate to the BRI in 1987.

Work on the grass tribe Arundineae has progressed well during the past year: three basic chromosome numbers, i.e. 6, 7 and 13, were found and it has been determined that large-scale evolution of the karyotype occurs in this group. This could indicate how the tribe has evolved and how an unfavourable environment may influence evolutionary development.

Mrs H. du Plessis studied the cytogenetic aspects of the important pasture grass, *Heteropogon contortus*: the species has a basic chromosome number of 10, both aneuploidy and polyploidy occur and paracentric inversions are found in some specimens. These phenomena explain the tremendous morphological variation in the species and show that any effort to improve the plant should be preceded by a cytogenetic study.

Mrs E.J.L. Saayman established that the C_3 form of *Alloteropsis semialata* is diploid and the C_4 form is hexaploid. Further study is needed to determine whether the two forms are merely mimics, whether the C_4 form is caused by an additional genome or whether pleiotropism and/or multifactorial heredity have caused the evolutionary change.

Mrs E. van der Merwe's cytogenetic investigation of certain *Digitaria eriantha* strains selected for breeding better strains, indicates that some strains exhibit abnormal meiotic chromosome behaviour. The associated decline in fertility renders these strains unsuitable for use in breeding programmes. The available commercial strains contain different polyploidy levels. Because diploid plants are usually more fertile than polyploid plants, natural selection against polyploidy occurs. The occurrence of sexual diploid plants entails that seed has to be increased in isolation in order to diminish variation within strains. Here one has to guard constantly against inbreeding.

A study of the tribe Ehrharteae showed that the tribe has a secondary basic chromosome number of $x = 12$. Polyploidy occurs and the highest polyploidy level is decaploid. B-chromosomes occur in some specimens.

Comparative anatomy

Dr R.P. Ellis continued to work with Dr H.P. Linder of the University of Cape Town on taxonomic studies of the genus *Pentaschistis*. A revision of the genus has been completed. The names of 67 species were typified and 16 new taxa described. The study revealed that, in addition to spikelet morphology, leaf anatomy is very valuable in the delimitation of species. An extensive anatomical atlas of the genus is being compiled, comprising detailed studies of the glands and the general biology of the genus. They will serve as a basis for further research on the delimitation of generic groupings in the Arundineae.

Mary Gunn Library

The librarians, Mrs E. Potgieter and B.F. Lategan, have had a busy year. The demand for library services has increased remarkably. This fact is illustrated by the following figures, with those of the previous year indicated in brackets: books and journals loaned 2 186 (1 750), interlibrary loans handled 2 139 (2 123), enquiries 3 188 (2 629), photocopies 36 236 (28 360), books and journals bound 370 (270), books purchased 96 (224) and journals received 417 (411). Additional manpower is urgently needed to assist with the interlibrary loans and the associated photocopying. Apart from the tasks mentioned above, the entire journal collection was rearranged on new shelves installed to accommodate the anticipated expansion in the next decade.

Photography

Mrs A.J. Romanovski has once again experienced a very busy year as indicated by the following figures: 1 569 photographs were taken, 785 films were developed and 19 078 prints were made, of which 6 994 were for publication purposes.

VEGETATION ECOLOGY DIVISION

The functions of the Vegetation Ecology Division under Dr J.C. Scheepers are to study the vegetation of South Africa and its ecological relations. This work involves three main aspects: the identification, description, classification and mapping of the various kinds of vegetation; study of the ecological relationships of different kinds of vegetation—with one another and with the environment—and of the various processes and mechanisms that determine the behaviour of plant communities; and the application of such ecological knowledge to the management and utilization of vegetational resources (Figure 2).

Members of the Vegetation Ecology Division had the pleasure and privilege of meeting Professors Sandro and Erika Pignatti of Italy, during a Workshop on the phytosociological processing of large data sets and also during subsequent field excursions during January, 1989.

Transvaal bushveld and forest studies

Mr R.H. Westfall is studying the vegetation ecology of the Sour Bushveld of the Waterberg area of the central Transvaal. He has sampled 63 stands representing about 14 different vegetation types. A new method of illustrating vegetation structure using layer diagrams generated by a portable computer for each stand was developed. This method emphasizes the field layer cover as a proportion of the total layer cover. In only 12 % of the stands sampled was the field layer cover greater than 50 %. The method could prove very effective in identifying areas with a high erosion potential.

The vegetation ecology of the Upper Limpopo River Valley in the western Transvaal bushveld is being investigated by Mr J.M. van Staden. Particular attention

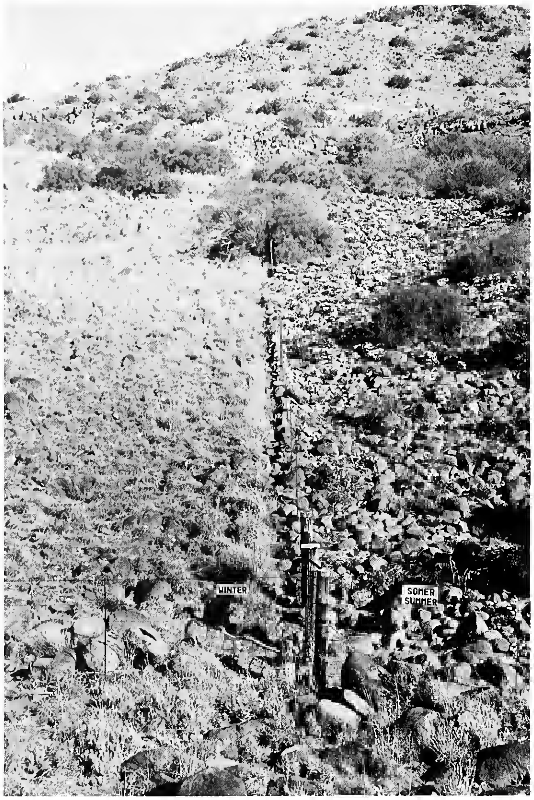

FIGURE 2.—A fence line on the Grootfontein Experimental Farm near Middelburg, Cape, showing the contrasting effects of winter (Feb.–Aug.) and summer(Aug.–Feb.) grazing on a Grassy Shrubland.

is being paid to bush encroachment and its effects on the grass cover. In this way, base-line data will also be obtained for monitoring the dynamics of veld condition and trend.

The work of Mr G.B. Deall on the Sabie transect has been completed. A trilogy of definitive publications is in press. A number of other texts is in preparation as unpublished reports and articles for publication.

Coastal studies

With the finalizing of the report on the conservation priorities in the tract between the Mozambique border and Sodwana, Dr P.J. Weisser has completed his coverage of the vegetation of the coastal dunes of KwaZulu. It is intended to publish this report in due course. Other data gathered during the subproject are to be worked up and published as a series of research papers.

The effects of the 1988 floods on the wetlands of the lower 5 km of the Orange River have been investigated by Mr M.G. O'Callaghan. In this area, 320 ha of wetland vegetation was destroyed, owing mainly to the deposition of sand as bedload. Approximately 50 ha of potential wetland area was added. To clarify and authenticate herbarium and other records, over 500 *Sarcocornia* and *Salicornia* specimens from various herbaria were identified, necessitating 12 000 anatomical sections. It was found that 2% had been identified as the wrong genus and 30% had been identified as the wrong species. Of the latter, 9,4% were hybrids, whereas 8,4% were previously indeterminate.

Cape fynbos studies

The ecological study by Mr H.C. Taylor of Mountain Fynbos in the Cederberg is well advanced. Field work has been completed for the northern sector. Phytosociological classification of the data by means of the PHYTOTAB program package has been carried to an advanced stage. Apart from two distinct thicket communities, six major fynbos groupings have become apparent, reflecting the major habitats within the study area. Minor refractory groups are at present receiving closer attention.

Mr D.J. McDonald is making good progress on his ecological study of the fynbos and other vegetation of the Langeberg. Field sampling of the first transect through the Boosmansbos Wilderness Area is complete. Analysis of the data is well advanced and three vegetation types have been identified: Wet Fynbos, Mesic-Arid Mountain Fynbos and Afromontane Forest. Soil samples from selected relevés have been analysed and related to the different vegetation types. Sampling of a second transect at Swellendam is well advanced with 41 relevés completed.

Grassland studies

Field sampling of the grassland vegetation of the Amersfoort area of the Eastern Transvaal Highveld has been completed by Miss B.J. Turner. She experienced much difficulty in the data processing and the interpretation of the results to arrive at a practically useful classification. The data have been analysed and several communities have been distinguished. The report on this work is progressing well and is nearing completion.

Mr P.J.J. Breytenbach has made good progress on his study of the vegetation in the Grootvlei area of the south-central Transvaal Highveld. He has nearly completed the field sampling. Preliminary data processing has yielded very promising results. This study is intended to provide a link between the eastern and the western sectors of the Grassland Biome.

Karoo studies

The reconnaissance study of the Karoo and other vegetation in the Graaff-Reinet and Middelburg areas of the eastern Karoo Region has been completed by Mr A.R. Palmer. Eight manuscripts have been prepared for publication dealing with the syntaxonomy, synecology, plant-soil relationships, phytogeography and mapping of vegetation. The syntaxa are classified into five classes, nine orders and seventeen communities. The classes distinguished are Grasslands, Karoo Shrublands, Karoo Dwarf Shrublands, Subtropical Transitional Thicket and Riparian Thicket (Figure 3). The distribution of syntaxa corresponds to the steep precipitation gradients encountered in the study area.

Mr J.F. van Blerk has commenced a reconnaissance study of the Succulent Karoo vegetation in the Knersvlakte vicinity of the Van Rhynsdorp-Nuwerus area. This is a daunting task still in the early stages of preparation of field work.

Central technical support services

During the year, 583 references from 1987 and 1988 have been encoded and loaded onto ATMS by Miss A.P. Backer. Several literature searches were undertaken for researchers.

Further progress has been made on the ecological data bank by Mrs W. Jones. There are 45 data sets available on the computer of which 78% of the species names and 49% of the community names are available. The first retrieval program, viz. PHYTO 200, designed to retrieve species associated in a relevé with a particular species, is running successfully. One enquiry from outside South Africa has already been successfully answered with the aid of this program.

EXPERIMENTAL ECOLOGY DIVISION

The objective of experimental ecology is to provide a predictive understanding of processes at the ecophysiological level of the individual as well as at the population, community and ecosystem levels. To provide focus within this wide hierarchical range of systems, the Experimental Ecology Division, under Dr M.C. Rutherford, has concentrated on problem-related research of critical processes of stressed systems. This has concerned specific problems of the more arid, drought-stressed ecosystems, the alien invasive plant-stressed ecosystems as well as the special stresses that develop in the Fynbos Biome through substrate disturbance.

Various levels of active research liaison continue with the Botany Department of the University of Cape Town, with other researchers within the co-operative Fynbos and Karoo Biome Programmes, and with officers of the Winter Rainfall and Karoo Regions of the Department of Agriculture and Water Supply. In this regard, Dr Rutherford is now co-supervisor of two Ph.D. degree projects and one M.Sc. degree project whereas Mr G.W. Davis is the convenor of the highly successful Working Group on Commercial Wildflower Resources of the Fynbos Biome Project under the auspices of the Foundation for Research Development. This working group is stimulating effective dialogue between conservation managers (chiefly from forestry and nature conservation bodies), biological researchers (from both universities and state institutions) and commercial wildflower producers to promote far-sighted planning for utilization of fynbos veld as a renewable resource.

Fynbos reproductive ecology

Dr C.F. Musil has found that the post-fire reproductive success, measured in terms of seedling/parent ratios, of lowland fynbos species with small seeds growing in sand plain communities infested by alien *Acacia saligna* was not significantly different to that in surrounding natural vegetation. Indigenous species with large seeds exhibited a significant reduction in post-fire reproductive success in the alien-infested communities. Efficiency of post-fire vegetative reproduction among indigenous species in alien-infested communities was similar to that in surrounding natural vegetation. Season of burn (autumn or spring) had no significant effect on total, indigenous seedling population densities. However, higher densities of sprouters were found after autumn than after spring burns, which may be related to increased mortalities among sprouters during the dry summer period.

Fynbos transformation studies

An experimental plant community at a mountain fynbos study site, which had been subjected to experimental disturbance by tilling, was shown by Mr G.W. Davis and Mr A.P. Flynn to retain altered compositional characteristics for at least three years following disturbance. Relative to an adjacent undisturbed control, it maintained: poorer species richness; a lower index of diversity (Shannon-Wiener index); and a higher index of dominance (Simpson index). Germination in seeds of the dominant shrub species (*Leucadendron xanthoconus*) was shown to be affected by ambient conditions known to be altered by tillage. Germination success under controlled environment conditions was inversely related to water stress, depth of seed burial, and an ambient daytime temperature greater or less than an optimum of approximately 15°C.

FIGURE 3.—Researchers from the Karoo Biome Project surveying Dwarf Shrubland near Prince Albert.

Ecophysiology in alien invasive plant-stressed ecosystems

Dr Rutherford's and Mr J. de W. Bösenberg's simulation of *Acacia cyclops* canopy radiation attenuation by replicated field shade units has started to identify shade-sensitive species in the second year of treatment. It appears that the negative reaction of species, such as *Anthospermum spathulatum*, to *A. cyclops* might be attributable to light limitation of obligate heliophytic species. However, several other amensalistic species, relative to *A. cyclops*, have not yet been adversely affected by one-and-a-half years of strongly reduced light levels, and allelopathic tests are consequently being initiated.

In a comparative study of photosynthetic responses of *A. cyclops* and of an indigenous colonizer of similar habitats, *Leucospermum rodolentum*, Dr Rutherford, Mr G.F. Midgley and Mr Bösenberg, have related carbon uptake patterns to photosynthetically active radiation, leaf temperature, vapour pressure deficit, stomatal conductance and xylem pressure potentials. Although the two seedling populations had similar light compensation points, at high light intensities *L. rodolentum* seedlings had much higher photosynthetic rates and were even less light saturated when compared with the seedlings of *A. cyclops*. These findings are being related to the patterns of establishment of these species in disturbed habitats.

Nutrient and water relations in Karoo

Mr G.F. Midgley has determined that, in an arid region, success of certain deciduous shrubs relative to evergreens may be determined primarily by soil nitrogen status, with soil water availability a secondary factor. This is possibly explained by deciduous forms having a higher nutrient requirement than evergreens. In a field-simulated drought, succulent plant forms were more negatively affected than were non-succulents. These results suggest that rainfall frequency and soil nutrient status are important determinants of vegetation composition in semi-arid parts of the western Karoo, and that leaf habit and water storage characteristics may determine the distribution and success of perennial plant forms in these areas.

Plant population response ecology in Karoo

Mr L.W. Powrie has been constructing a computer database of important responses to major events in the autecology of karroid plant populations, using both the formal, scientific and the largely untapped informal, undocumented information sectors. To date he has collected data from 21 agricultural workers in the Karoo for creating the database. There are data on some 226 worksheets, from which 61 partial species descriptions have been entered into the computer database. A list of some 1 250 botanical and common names has been compiled from several sources. The unusual rains, floods and large locust outbreaks during 1988, have provided further opportunities for observing responses of Karoo plants.

PLANT EXPLORATION DIVISION

The division, under Mr M.J. Wells continued to concentrate on problem plants and food plants, but the loss of research staff resulted in greater emphasis being placed on the scientific information and garden utilization services.

Conservation of germ plasm

With the field work on Mr T.H. Arnold's investigation of tribal crop plants having been completed, no more seed samples were forthcoming from this source. Seed previously collected was distributed: 10 samples of *Vigna unguiculata* and six of *Voandzeia subterranea* to France. Mrs H. Joffe collected 84 seed and 23 vegetative samples for distribution to local nurseries, in order to encourage cultivation of indigenous plants.

Indigenous food plants

Mr A.A. Balsinhas abstracted information from 60 publications, bringing the references consulted for the national food plants data bank to a total of 284. The newly consulted references contributed information about 2 354 species and resulted in the addition of 96 new names to the list of southern African food plants which now includes 1 793 species.

Miss S.E. Chadwick prepared a manuscript on *Tylosema esculentum*, the 10th of 14 priority food plants of the veld that are being studied. Photographs and diagnostic descriptions are required before these texts are ready for publication. She also prepared the text for a plate in *The Flowering Plants of Africa* on another plant with edible seeds—*Citrullus ecirrhosus*.

Primitive crop plants of African origin

Mrs L.D. Jacobs completed the preparation of material resulting from the previous year's field trips. This included 56 tannin tests and 250 colour tests on *Sorghum* seed, and the completion of 215 data sheets on *Pennisetum*. She also dissected and prepared slides of spikelets from 61 collections of *Sorghum* and *Pennisetum*.

Data was prepared for a paper to be entitled 'A survey of frequency of and preference for primitive crops' in five ethnic regions (KwaZulu, KwaNdebele, Bophuthatswana, Caprivi and Kavango). This will complement a survey, previously completed, on other ethnic regions. In addition maps were prepared of the occurrence (and preference ratings) for all regions of the following crops: *Sorghum, Pennisetum, Zea, Citrullus, Cucurbita, Lagenaria, Voandzeia, Vigna, Arachis, Phaseolus* and *Cajanus*.

Catalogue of problem plants

More information about listed and additional species was filed by Mr Wells for possible future editions of the catalogue. The existing catalogue, despite its incompleteness, continues to be invaluable in answering queries regarding weeds and invaders.

Plant invaders

A series of 14 radio talks on the introduction of invader plants was prepared and recorded by Mr Wells. Mrs D.M.C. Fourie also recorded radio talks on our publication 'Declared weeds and invader plants'. Although Miss L. Henderson (of the Plant Protection Research Institute) is

no longer on our staff we continue to assist her with her plant invader surveys, where possible, and Mrs H. Joffe accompanied her on a field trip to the eastern Cape.

Garden utilization

Mrs H. Joffe continued to increase the level of garden utilization. She made 430 seed collections of which 150 were to meet requests from researchers, 91 were for the herbarium's carpological collection, 82 for the spirit collection, and 23 were channelled back to the nursery for propagative purposes. She also made 380 collections of flowering or vegetative material, of which 57 were to meet requests from local or overseas researchers, 202 were added to the herbarium spirit collection and 42 were channelled back to the nursery for propagative purposes. Eleven collections were made for the artist to figure. Colour slides taken, annotated and filed totalled 450. Some 130 herbarium specimens were made, mainly as vouchers for plants that were photographed or from which seed or other collections were made.

Scientific information services

Mrs D.M.C. Fourie handled 286 written and 143 telephonic requests for material and information, and dealt with 32 visitors and four groups. She also catalogued and filed 442 articles and letters in our special information files, in preparation for future enquiries.

Among the requests dealt with were advice on new stamp issues and texts for stamps illustrating indigenous plants.

A layman's guide to botanical publications

The draft list was circulated to publishers and to botanical organizations for comment and suggested additions. Response was good and about 100 references were added, bringing the total to 455. The list can now be finalized and the references classified.

A survey of cultivated plants in South Africa

Ms Susyn Andrews, horticultural botanist from Kew, was assisted in making contacts with local horticulturalists. Her survey, when completed, will be of great assistance in identifying and naming cultivated plants. She has already shown that many names in use in the trade are incorrect or out of date.

History of the Botanical Research Institute

Mrs Fourie, who has been gathering historical material from Miss M.D. Gunn and others, completed the history of the Institute up until the end of Dr Pole Evans' tenure (1939). A talk entitled 'The early years' was given to staff members and a few invited guests. She has been fortunate in being able to assemble a fascinating photographic record. Work will now begin on the next period, and ultimately the completed work will be published.

Liaison services

In the absence of a liaison officer Mrs Fourie accepted visits of a few groups that she felt merited special assistance, e.g. black school teachers and overseas conference delegates. Mr Wells also organized visits from delegates to the congress of the South African Association of Botanists. Mrs Joffe assisted a few garden tours, but many requests for tours of the Institute and garden had to be turned down.

PRETORIA NATIONAL BOTANICAL GARDEN

Under the direction of the curator, Mr D.H. Dry, the garden staff were able to continue with new developments, despite increased garden maintenance needs that resulted from heavy rains. Coping with aggressive weed growth was a particular problem.

A field trip to the northern Transvaal, undertaken by Mr D.S. Hardy and Mr D.J.F. Strydom added valuable live and herbarium material, as well as seeds to the existing collections. Mr N.F. van Zyl accompanied by Dr D. Lehmiller, an American *Crinum* enthusiast, managed to collect live material of all Namibian *Crinum* species bar one elusive species. Mrs K.P. Clarke, the garden records officer, recorded 647 new accessions to the garden, of which about 100 are classified as rare or endangered species.

Messrs Strydom and N.A. Klapwijk sealed three of the four earth dams in the general section of the garden with bentonite clay. The pond in front of the main building was also sealed and the fountain made operative. The area around the entrance gate to the main building was landscaped by using boulders as the main feature. The fountain and the boulder 'koppie' greatly improve the approaches to the building.

In the Coastal Forest Biome near the Silverton gate, two new plant beds were made, while additional plantings were made to other existing beds in the Biome. Mr L.C. Steenkamp, who recently turned 73, and his team of workers paved 480 m of new nature trails.

The old extractor fan and obsolete wet wall of the orchid house were renovated by Messrs Klapwijk and Van Zyl and installed in the smaller ornamental glasshouse where they function very well.

Mr Hardy was sponsored to attend the International Symposium on Bulbous & Cormous Plants, arranged by the American Plant Life Society at the Irvine campus of the University of California. He also delivered eight talks on South African succulents at various venues in the USA.

Mr Van Zyl resigned from the Institute at the end of February 1989: unfortunately staff with experience in our garden seem to be very sought after!

BIOSYSTEMATICS DIVISION

This division, under the direction of Dr O.A. Leistner, has devoted itself largely to the editing and typesetting of the publications of the Institute. Mrs E. du Plessis assisted with editing *The Flowering Plants of Africa* and *Flora of Southern Africa* and undertook most of the translation work for the Institute. Mrs B.A. Momberg assisted with editing *Bothalia* and *Memoirs of the Botanical Survey of South Africa*. An increased amount of typesetting was done in-house by Mrs S.S. Brink.

Bothalia

Numbers 1 and 2 of Vol. 18 and the index to Vol. 17 were published.

Flora of southern Africa (FSA)

Vol. 16,3,6, dealing with the 278 species of *Aspalathus* of the Fabaceae was published.

The Flowering Plants of Africa/Die Blomplante van Afrika

As mentioned in the introduction a new green cover was designed for this journal with a reduced print of one of the plates in the journal on the front. Beginning with volume 50,1 which was published during the year, each volume will consist of 2 numbers with one number containing 20 plates published per year.

Palaeoflora of southern Africa

Vol. 2 of the Molteno formation has gone to press.

Memoirs of the Botanical Survey of South Africa

No. 57, the third edition of John Acocks's (Figure 4) classical work *Veld types of South Africa* (Figure 5) was published. Plant names have been updated and minor adjustments and corrections made in the text. The text was set at the Institute. Many new and more relevant photos were chosen to illustrate veld types.

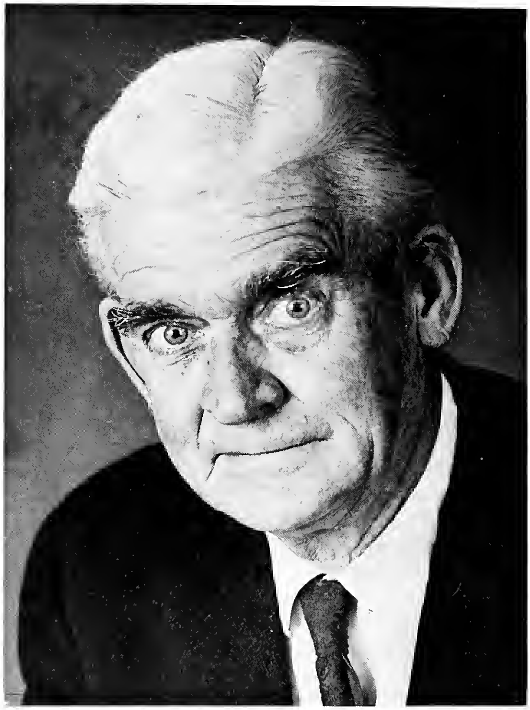

FIGURE 4.—John Phillip Harison Acocks (1911–1979).

SEMINARS

The seminar committee, under the chairmanship of Dr J.J. Spies organised the following lectures:

1988.05.20
Mr J. van Blerk (BRI): Die verwerking van Acocks se ongepubliseerde velddata met behulp van moderne rekenaarmetodes.

1988.05.26
Dr D.J.B. Killick (BRI): Linnaean typification.

1988.05.26
Mr T. Arnold (BRI): Computerization of curatorial and plant identification functions of the National Herbarium.

1988.08.25
Prof. D. Wiens (Department of Biology, University of Utah, Salt Lake City, Utah 84112, USA): Reproductive failure in plants: a genetic hypothesis for extinction.

1988.09.15
Dr C.L. Calvin (Department of Biology, Portland State University, Portland, OR 97207, USA): A quantative approach to studying endophytic system development in mistletoes.

1988.11.18
Mrs H. du Plessis (BRI): Die gebruik van sitogenetika in die taksonomie van *Tribolium*.

1988.12.01
Mrs D. Fourie (BRI): The history of the BRI: the early years.

1989.02.17
Dr H. Anderson (BRI): The palaeoflora of South Africa —past, present and future.

FIGURE 5.—The 3rd edition of Acocks's *Veld types of South Africa* was published at the beginning of 1989. Persons largely involved in the production of this work were from left to right: Dr O.A. Leistner (editor); Mrs B.A. Momberg (assistant editor); Mrs S.S. Brink (typesetter) and Dr J.C. Scheepers (photographs).

BOTANICAL RESEARCH INSTITUTE

Scientific, Technical and Administrative Staff

(31st March 1989)

Director

B. de Winter, M.Sc., D.Sc. (Taxonomy of Poaceae, especially *Eragrostis*, and of *Hermannia*; plant geography)

Deputy Director

D.J.B. Killick, M.Sc., Ph.D., F.L.S. (General taxonomy; nomenclature; mountain ecology and editing)

ADMINISTRATION DIVISION

Chief Provisioning Administration Clerk	J.T.C. Snyman (Head of Division)
Senior Provisioning Administration Clerks	Mrs E.S. Smit Mrs A.E. Engelbrecht
Personal Secretary to Director	Mrs M.M. Loots
Senior Registration Clerk	Mrs I.J.H. Joubert
Registration Clerk	Mrs R.W.R. Koehne
Accounting Clerk	G. Herman
Receptionist	Mrs A.E. van der Merwe
Typists	Mrs S.S. Brink Mrs E.L. Bunton* Mrs S.M. Thiart

HERBARIUM DIVISION

Officer-in-Charge	T.H. Arnold, M.Sc.
Acting	Miss W.G. Welman, M.Sc.

NATIONAL HERBARIUM, PRETORIA (PRE)

Assistant Director	T.H. Arnold, M.Sc. (Curator; taxonomy of *Ficinia*)
Herbarium Assistant	Mrs C.J. van Niekerk

Wing A (Pteridophytes—Monocotyledons)

Senior Agricultural Researcher	Miss C. Reid, B.Sc. Hons (Taxonomy of *Carex*; plant identifications)
Chief Agricultural Research Technician	Mrs L. Fish, B.Sc. (Plant identifications)
Herbarium Assistant	Mrs S. Burger
Administrative Assistant III	S. Makgakga

Wing B (Piperaceae—Oxalidaceae)

Senior Agricultural Researcher	G. Germishuizen, M.Sc. (Taxonomy of Polygonaceae; plant identifications)
Senior Agricultural Researcher	Miss E. Retief, M.Sc. (Plant identifications)
Chief Agricultural Research Technician	Mrs B.J. Pienaar, B.Sc. Hons (Taxonomy of *Vigna*; plant identifications)
Administrative Assistant III	C. Letsoalo

Wing C (Linaceae—Asclepiadaceae)

Senior Agricultural Researcher	Mrs C.M. van Wyk, M.Sc. (Plant identifications)
Senior Agricultural Technician	Mrs M. Jordaan, B.Sc. (Plant identifications)
Assistant Agricultural Research Technician	N.P. Barker, B.Sc. Hons. (Taxonomy of *Pentameris* and *Pseudopentameris*)
Agricultural Research Assistant	A.A. Balsinhas** (Plant identifications)
Herbarium Assistant	Mrs J.L.M. Grobler*

Wing D (Convolvulaceae—Asteraceae)

Senior Agricultural Researcher	Miss W.G. Welman, M.Sc. (Plant identifications)
Senior Agricultural Researcher	P.P.J. Herman, M.Sc. (Plant identifications)
Principal Agricultural Research Technician	Mrs M.J.A.W. Crosby*, B.Sc. (Plant identifications)
Administrative Assistant III	J. Phahla

Cryptogamic Herbarium

Agricultural Researcher	F.A. Brusse, M.Sc. (Lichens)
Assistant Agricultural Researcher	J. van Rooy, B.Sc. Hons (Musci)
Chief Agricultural Research Technician	Mrs S.M. Perold*, B.Sc. (S.E.M. technician; taxonomy of Ricciaceae)
Herbarium Assistant	Mrs L. Filter*

* Half-day
**Part-time assistance

Herbarium services

Senior Agricultural Technician	Mrs M. Jordaan, B.Sc. (Controlling Officer)
Herbarium Assistants ...	Mrs M. Dednam* (Plant identification services) Mrs M.Z. Heymann* (Loans and exchanges) Miss M. Francis
Typist	Mrs M. Cloete*
Administrative Assistant III	G. Lephaka (Preparation and packaging)

NATAL HERBARIUM, DURBAN (NH)

Assistant Agricultural Researcher	Miss R. Williams, B.Sc. Hons (Curator; plant identifications)
Provisioning Administrative Clerk	Mrs H.E. Noble*
Administrative Assistants III	A.M. Ngwenya T.B. Sikhakhane
Administrative Assistants II	B.M. Mbonambi S.B. Nzimande (Gardener)

GOVERNMENT HERBARIUM, GRAHAMSTOWN (GRA)

Senior Agricultural Researcher	Mrs E. Brink, B.Sc. (Curator; plant identifications)
Herbarium Assistant	Mrs L.M. Verwey
Administrative Assistants III	A.D. Booi R. Klaas (Grahamstown Nature Reserve)
Administrative Assistant I	J. Zenzile

GOVERNMENT HERBARIUM, STELLENBOSCH (STE)

Senior Agricultural Researcher	E.G.H. Oliver, M.Sc. (Curator; taxonomy of Ericaceae)
Assistant Agricultural Researcher	Mrs J.B.P. Beyers, B.Sc. Hons (Plant identifications)
Agricultural Research Technician	Mrs A.C. Fellingham, B.Sc. (Plant identifications)
Administrative Assistants III	Mrs J. Leith Miss E. van Wyk

VEGETATION ECOLOGY DIVISION

Assistant Director	J.C. Scheepers, M.Sc., D.Sc. (Vegetation ecology, especially of forest/woodland/grassland relationships; conservation and land-use planning; phytogeography)
Senior Agricultural Researchers	D.J. McDonald, M.Sc. (Mountain fynbos ecology and phytosociology; Braun-Blanquet approach and techniques) A.R. Palmer, Ph.D. (Karoo ecology; remote sensing; nature conservation; vegetation mapping) H.C. Taylor, M.Sc. (Mountain fynbos and forest ecology; Braun-Blanquet approach and techniques; conservation) P.J. Weisser, Ph.D. (Forest ecology; air-photo interpretation and mapping; reedswamp ecology; Zululand coast dune vegetation; conservation) R.H. Westfall, M.Sc. (Ecology and phytosociology of Transvaal bushveld; ecological data and literature storage, retrieval and processing; syntaxonomic nomenclature)
Agricultural Researcher	M.G. O'Callaghan, M.Sc. (Estuarine ecology and phytosociology; land-use planning and management; nature conservation)
Assistant Agricultural Researchers	P.J.J. Breytenbach, B.Sc. Hons (Grassland ecology; pasture science; nature conservation) Miss B.J. Turner, B.Sc. Hons (Grassland ecology; pasture science; nature conservation) J.F. van Blerk, B.Sc. Hons. (Succulent Karoo ecology; ecological literature; pasture science; photography) J.M. van Staden, B.Sc. Hons. (Bushveld ecology; pasture science; nature conservation; photography)
Principal Agricultural Research Technicians .	Miss A.P. Backer, B.Sc. (Ecological data processing and presentation; ecological literature; nature conservation; air-photo interpretation and cartography; photography) M.D. Panagos, N. Dipl. Agric. (Bot.Res.)(Computer science; data processing; sampling and monitoring vegetation and environment) Mrs J. Schaap, H.P.E.D. (Draughtsmanship and carto-

* Half-day

graphy; artwork, layout and design)

Agricultural Research Technicians .... Mrs W. Jones, B.Sc. (Computer science; ecological data processing and presentation; remote sensing; airphoto interpretation and cartography)
W.J. Myburgh, B.Sc. (Grassland ecology; pasture science; nature conservation)
C.M. van Ginkel, N. Dipl. (Nat. Cons.) (Karoo ecology; nature conservation; photography; remote sensing)
P. Zeier, B.Sc. (Ecological data processing and presentation; ecological field methods; ecological literature; Succulent Karoo ecology)

Agricultural Research Assistant .... Miss H.M. Moolman, T.H.E.D. (Technical, editorial and administrative support functions)

EXPERIMENTAL ECOLOGY DIVISION

Assistant Director .... M.C. Rutherford, M.Sc., Ph.D., Dipl. Datamet. (Primary production ecology of terrestrial ecosystems; experimental ecological studies in strandveld, fynbos and Karoo)

Senior Agricultural Researcher .... C.F. Musil, M.Sc., Ph.D. (Reproductive ecophysiology in fynbos)

Agricultural Researchers .... G.W. Davis, M.Sc. (Transformations of fynbos ecosystems by the wild flower picking industry)
G.F. Midgley, B.Sc. Hons (Plant stress ecology in Karoo ecosystems)
L.W. Powrie, M.Sc. (Plant population response ecology in Karoo)

Senior Research Technicians .... A.P. Flynn, B.Sc. (Fynbos ecology; plant community development)
J. de W. Bösenberg, B.Sc. Hons (Fynbos and Karoo ecology; monitoring effects of alien plants on strandveld and fynbos)

* Grassland Research Centre
** Library Services, Department of National Education
† Half-day

Senior Provisioning Administration Clerk .. Mrs E.W. Lewis

Agricultural Research Assistant .... D.M. de Witt (Laboratory, field and curatorial assistance)

General Assistant .... S.V. Dolo

PLANT STRUCTURE AND FUNCTION DIVISION

Officer-in-Charge .... J.J. Spies, M.Sc., Ph.D.

CYTOGENETICS

Assistant Director .... J.J. Spies, M.Sc., Ph.D. (Cytogenetics of grasses)

Agricultural Researcher Mrs E. van der Merwe, M.Sc. (Cytogenetics of *Digitaria*)*

Assistant Agricultural Researcher .... Mrs H. du Plessis, B.Sc. Hons (Cytogenetics of grasses)

Agricultural Research Technician .... Mrs E.J.L. Saayman, B.Sc. Hons (Cytogenetics of grasses)

Agricultural Research Assistant .... Miss C.C. Steyn (Microtechnique)

COMPARATIVE PLANT ANATOMY

Specialist Scientist ...... R.P. Ellis, M.Sc., D.Sc. (Anatomy of grasses)

Agricultural Research Assistant .... Mrs A.G. Botha (Microtechnique)

PHOTOGRAPHIC SERVICES

Photographer .... Mrs A.J. Romanovski

MARY GUNN LIBRARY

Senior Librarian . Mrs E. Potgieter, B.Bibl.**
Library Assistant .... Mrs B.F. Lategan†**

PRETORIA NATIONAL BOTANICAL GARDEN

Chief Agricultural Research Technician .. D.H. Dry, NTC Dip. (Hort.) (Curator; special interest *Ocotea bullata* and *Xerophyta retinervis*)

Chief Agricultural Research Technicians . D.S. Hardy (Nursery supervision, succulents and orchids)
D.J.F. Strydom, NTC Dip. (Hort.), Dip. Rec. P.A. (Supervision northern section of the garden)

Agricultural Research Technicians .... N.A. Klapwijk, NDH (Supervision southern section of garden)

	N.F. van Zyl, NDH (Propagation for main plantings)
Agricultural Research Assistant	Mrs K.P. Clarke (Garden records)
Farm Foremen	L.C. Steenkamp (Supervision of labour)
	G.R. Lubbe (Workshop and stores)

PLANT EXPLORATION DIVISION

Assistant Director	M.J. Wells, M.Sc. (Weeds research, botanical horticulture, fynbos utilization and conservation)
Chief Agricultural Research Technician	Mrs D.M.C. Fourie*, B.Sc. (Scientific information service)
Senior Agriculture Research Technician	Mrs H. Joffe*, B.Sc. (Garden utilization)
Agricultural Research Technician	A.A. Balsinhas** (Indigenous food plant data bank)

FLORA RESEARCH DIVISION

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Senior Agricultural Researcher	H.F. Glen, M.Sc., Ph.D. (Taxonomy of *Aloe*)
Assistant Specialist Scientist	J.M. Anderson, M.Sc., Ph.D. (Palaeobotany, plant geography)
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	B.D. Schrire, M.Sc. (Taxonomy of Fabaceae, electronic data processing)
Assistant Agricultural Researcher	H.M. Anderson, M.Sc., Ph.D. (Palaeobotany)
Agricultural Research Technician	Miss M. Koekemoer, B.Sc. Hons (Grass species monographs)
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Data typist	Mrs J.M. Mulvenna (Data input)
Agricultural Research Assistants	Mrs E.B. Evenwel (Quality control for PRECIS)
	Mrs B.J. Harris (New specimen encoder for PRECIS)

BIOSYSTEMATICS DIVISION

Assitant Director	O.A. Leistner, M.Sc., D.Sc., F.L.S. (Editing)
Senior Liaison Officer	Mrs E. du Plessis, B.Sc. Hons, S.E.D. (Editing and translating)
Senior Agricultural Research Technician	Mrs B.A. Momberg*, B.Sc. (Editing)

* Half-day
** Part-time assistance
*** Biometry & Datametrics

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OBITUARY

INEZ CLARE VERDOORN (1896–1989)

Friends and colleagues were saddened to hear of the death on the 2nd April 1989 of Inez Clare Verdoorn (Figure 1), the doyenne of South African botany.

She was born in Pretoria on the 15th June 1896. Her father was a surveyor's draughtsman and her mother was the sister of the noted Afrikaans writer, poet, lawyer and naturalist, Eugène Marais.

During her early school years Inez was troubled by ill-health. She later attended the Pretoria High School for Girls and the Loreto Convent where she matriculated in 1916. In her last year at school she wrote an essay which was to prove crucial to her career and to have a marked influence on botanical science in South Africa. After a school visit to the Division of Botany, which at the time was headed by the dynamic Dr Illtyd Pole Evans, she penned her impressions of the visit and these were included in the school's letter of thanks to the Division. When the post of herbarium assistant fell vacant, Pole Evans was determined to acquire the services of Inez Verdoorn. After matriculating she had started work in the war office of Transport and Remounts, but thinking this might not be a sufficiently permanent position, she transferred to the Controller and Auditor General's office. When she was informed of the vacant herbarium post, she was unsure as to whether she should make the change, as she was happy in her work in spite of finding it rather dull. But Pole Evans, who had decided that Inez Verdoorn should join his Division, used his influence to obtain her transfer to his staff.

She started work at the Division on the 1st April 1919. As an herbarium assistant she was responsible for the pressing, drying and mounting of hundreds of specimens (Figure 2). However, Inez's inherent curiosity did not allow her to settle happily into this mundane work. One day she asked Miss Sydney Stent, the curator of the herbarium, why two plants that looked so similar should have two completely different names. The plants in question were a species of *Chrysanthemum* and one of *Pentzia*. She was instructed to take Volume 3 of *Flora capensis* and find out for herself. With a primitive microscope Inez studied the dissected flowers and in her own words 'I can't tell you what it did to me—it was so wonderful'. She had found the path she was to follow for the rest of her life. And it was perhaps during these early formative years in the herbarium that the qualities which were to make her great became evident. Her sense of humour stood her in good stead as she was teased endlessly by her more learned colleagues Sydney Stent and Zoë Findley. But the atmosphere in the herbarium was one of real happiness together with complete dedication to the work and Inez must have played a large part in the cameraderie that developed amongst the members of staff. She had a genuine love for and interest in people from all walks of life, was a devout Christian, and when in the years to come she was to be honoured in many ways, her abiding humility was to prove one of her greatest attributes.

In 1920 Inez tried to obtain a higher qualification and enrolled as a part-time student at the Transvaal University College. Here she coped well with botany and zoology but found chemistry a problem. It was difficult to manage the extramural work and ill-health was again causing problems. Pole Evans advised her to forget about university and concentrate on her herbarium work. It was therefore left to her to provide her own botanical education. By 1925 the young botanist had achieved such a degree of proficiency that she was considered a suitable successor

FIGURE 1.—Inez Clare Verdoorn (1896–1989), still at work in 1978.

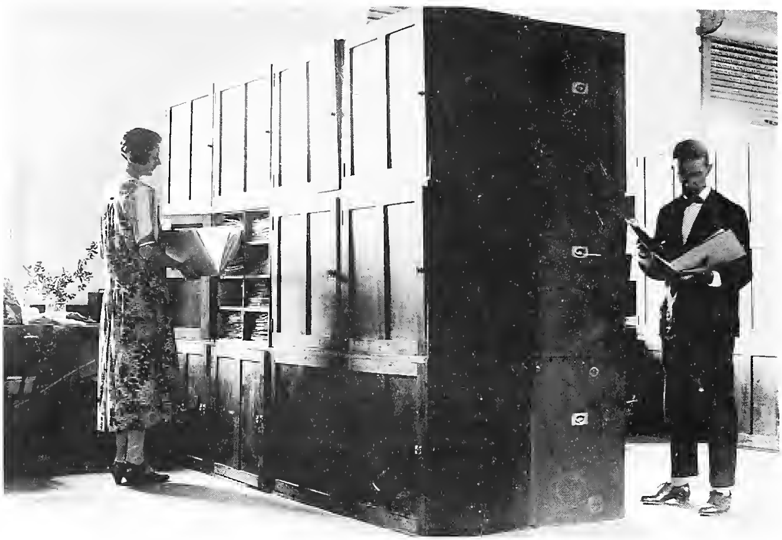

FIGURE 2.—Inez Verdoorn and Jim Howlett in 'New Herbarium', ± 1923.

to the first South African Liaison Officer at the Royal Botanic Gardens, Kew. Her work at this mecca of the botanical world was to serve as a further inspiration to her research.

On her return to South Africa in 1927 she completed one of her important early works: a revision of the genus *Crotalaria* in south and south-east tropical Africa. Her first scientific publication had been 'The genus *Fagara*' which appeared in 1919. In total she published more than 300 articles and papers (Appendix). Amongst the more important of these were revisions of genera which, apart from those already mentioned, included *Plinthus, Crinum, Waltheria, Cola, Melhania* and *Hermannia* subgenus *Hermannia*. Families revised for the *Flora of southern Africa* were Oleaceae, Salvadoraceae, Loganiaceae, Gentianaceae, Zamiaceae and Welwitschiaceae.

Having been responsible for her own botanical education, Inez was always aware of the need to teach laymen about the wonders of the plant world. A large number of her publications were prepared with this communication link in mind. Amongst these were *An introduction to botany and to a few Transvaal flowers* (1934), *Edible wild fruits of Transvaal* (1938), articles for a number of primary school books, as well as a large number of articles in popular journals. She also contributed extensively to botanical articles in the twelve volumes of the *Standard encyclopedia of South Africa* (1970–1972). She was the single most important contributor of text in the *Flowering Plants of Africa* series and provided a formidable total of 159 descriptions to accompany the botanical illustrations. Inez Verdoorn is considered to be the main instigator and stimulus behind the *Flora of southern Africa* project (Figure 3). Her last major generic revision, that of *Hermannia* subgenus *Hermannia*, was published in 1980. With the publication of a few minor papers up to 1984 she achieved a time span of 65 years between her first and final papers. This is a record of scientific productivity which will not easily be matched. In recognition of her achievements the following publications were dedicated to her: Volume 28 of *Flowering Plants of Africa*, Volume 40 of the *Journal of South African Botany* and Eve Palmer's *A field guide to the trees of southern Africa*.

In 1944 Inez became one of only two employees in the Department of Agriculture to be promoted to a professional post without the prescribed academic qualifications. She was placed in charge of the National Herbarium with the rank of Senior Professional Officer, a post she held until her retirement in 1951. This bold step by bureaucracy was vindicated when her achievements in the field of botany were acknowledged with the award of an honorary Ph.D. from the University of Natal in 1967.

As a member of various scientific societies Inez met researchers in many fields of biological science. She was always grateful to have learned so much from and been in touch with so many of the noted scientists of the early period of her work. People such as Pijper (Pathology), Jansen and Smit (Entomology), Theiler (Veterinary Science), Broom and Dart (Palaeontology) and Bigalke (Zoology) were to have a profound influence on the young girl who avidly listened to all the papers presented at scientific meetings. Inez was to offer her services to two of these scientific societies in the years to come. She was President of the South African Biological Society in 1956 and President of Section B of the South African Association for the Advancement of Science in 1963–1964. She was also a founder member of the South African Association of Botanists as well as a member of the South African Association of University Women, the Association for the Taxonomic Study of the Flora of Tropical Africa (AETFAT) and the South African Council of English Education. She was honoured by some of these associations with the presentation of a number of awards. She received the Senior Captain Scott Medal from the South African Biological Society in 1952 and the South African Association for the Advancement of Science presented her with their Certificate of Merit in 1977 and their Silver Medal in 1980. In 1981 she received the Senior Medal for Botany from the South African Association of Botanists.

Inez had a deep love of the veld and, in spite of difficulties with transport in the early days, she managed to make frequent field trips. Through the years she personally collected more than 4 000 botanical specimens and she joined forces with other collectors such as Codd and Dyer in expeditions which were to greatly increase the holdings of the National Herbarium. She was responsible for describing numerous new species. One of the highlights of her career was the description of a new *Encephalartos* species in 1945 which she named *eugene-maraisii* in honour of her uncle who had been the first person to inform her about the cycad in the Waterberg. She herself was commemorated by Dr Percy Phillips, her one-time Chief, who named the genus *Inezia* after her. A number of species named *'verdoorniae'* also acknowledge her contribution to botany. She was honoured in the entomological world when a beetle found on the cycad she had named after her uncle was named *Apinotropis verdoornae*. This new genus of beetle was found at the same time that she collected the cycad in 1944.

Following her retirement in 1951 Inez worked in a temporary capacity until 1968 after which she continued with her botanical research for a further 12 years. In her late eighties she would still board the bus which transported her from central Pretoria to the Botanical Research Institute which had become her second home. In all weathers she walked the long path through the garden to and from the herbarium and the bus stop.

The esteem in which Inez Verdoorn was held by her colleagues is illustrated in a statement made by Dr R. Allen Dyer, her close friend and Chief, when he proposed that the University of Natal award her with an honorary doctorate. He wrote: 'I received a number of scientific honours over the years but I have no hesitation in saying that much of what I achieved in my profession was due to her stimulating personality and example'. Throughout her career she had certainly set an example to both young and old botanists. She herself emphasized the fact that she had been inspired by three men: Dr Illtyd Pole Evans, Sir Arnold Theiler and General Jan Christiaan Smuts. She felt that these men epitomised the qualities of hard work, integrity, a love of nature and the environment, a love of humanity and a national pride. The example they set was one that she followed diligently. Her qualities are well summed up in the motivation read at the presentation of her doctorate in 1967: 'by her dedication to the ideals of science, by her modest and unobtrusive dignity and her resolution in defending those ideals, by the outstanding quality of her work, and her kindliness and courtesy as a botanical guide, philosopher and friend to presidents, prime ministers, professors, students and scholars she has become South Africa's most widely respected botanist'.

If Inez had ever made a plea for a long and fruitful life it could not have been more aptly put than in a verse by the botanical artist Cythna Letty, an associate and lifelong friend:

> God grant me many years
> That I may roam
> Unhindered on the Great Karroo, to know
> Each plant in flower
> Each bush in bloom

She was indeed granted those years and used them to the full.

FIGURE 3.—Publication in 1963 of Volume 26 of the *Flora of southern Africa*, the first volume in the series. From left, Dr R.A. Dyer, Dr L.E. Codd, I.C. Verdoorn and Dr B. de Winter.

PUBLICATIONS OF I.C. VERDOORN

THE FLOWERING PLANTS OF (SOUTH) AFRICA

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—1940b. *Gladiolus varius* var. *elatus*. Vol. 20: t. 791.
—1940c. *Echinops amplexicaulis*. Vol. 20: t. 796.
—1940d. *Thunbergia gibsonii*. Vol. 20: t. 800.
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—1941b. *Streptocarpus grandis*. Vol. 21: t. 803.
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—1941e. *Stapelia mcloughlinii*, sp. nov. Vol. 21: t. 812.
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—1941g. *Haworthia umbomboensis*, sp. nov. Vol. 21: t. 818.
—1941h. *Verbascum ternacha*, sp. nov. Vol. 21: t. 834.
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D.M.C. FOURIE

Book Reviews

TREES AND SHRUBS OF THE WITWATERSRAND, MAGALIESBERG AND PILANESBERG by J. VAN GOGH & J.M. ANDERSON. 1988. *Struik Publishers*, Oswald Pirow St, Foreshore, Cape Town 8001. Pp. 112. Size 280 × 215 mm. ISBN 0 86977 719 X. Price: hard cover R34,95 + GST.

This book has an unusual arrangement in that there is a minimum of text, most information being presented pictorially. Authors' notes and an explanation of how to use the book are followed by descriptive pages, each with two to four species, alternating with facing, detailed, watercolour illustration pages showing the species described opposite.

Descriptive pages show for each species, a habit drawing, a scale giving the approximate height of a mature specimen in its favoured habitat for the study area, very brief notes mainly on bark and foliage, a drawing indicating habitat and a distribution map.

The habitat drawing is purely topographical, no account being taken of soil types. It is in effect an oblique aerial view from the east of a stylised portion of Magaliesberg range and surrounds, with the particular species marked thereon in green. A key drawing in the explanatory notes defines the various habitats.

On the distribution maps the occurrence of a species is indicated by a green area of varying size depending on the extent of the presence. With the aid of a transparent overlay, on which a particular point has been marked, positioned successively on each of the maps, it should theoretically be possible to ascertain the various species which occur at the selected point. However, the maps are very small and minor occurrences of a species may be very difficult to discern, particularly in artificial light, and in the case of minute green areas situated next to rivers and dams which are shown in blue. A slight re-arrangement would have made it possible to increase the size of these maps by a not insignificant 15%, without altering the overall page layout.

Draughtsmanship of the coloured illustrations is, in general, reasonably good but the painting has, in most cases, a slap-dash or hurried appearance which is surprising as this work was not done in the field. The lack of variation in the greens has been criticised by various indigenous tree enthusiasts and a colour expert. This could be due to a low standard of the colour photo-prints from which the paintings were done, or to poor colour reproduction, or both.

The book title is decidedly ill-chosen. 'Trees and shrubs of the Witwatersrand' appears in large print followed by an unobtrusive 'Magaliesberg and Pilanesberg' in small print—as though it was an afterthought. The first portion is identical to the title of the Tree Society work, first published in 1964 and now well into its third edition. This must inevitably lead to confusion. In addition, it should have been the trees and shrubs of the Pilanesberg and Magaliesberg, in that order, that required any emphasis, as the flora of those areas is likely to be with us a good deal longer than that of the Witwatersrand, which is rapidly vanishing under tar and concrete. Incidentally, both authorship and publisher of the Tree Society publication were incorrectly attributed in the list of reference works.

The authors are of course to be commended for the time and effort expended. It is no mean accomplishment to put together a work of this sort. They have provided a valuable record of the species which occur, or did once occur, in an area which, taken overall, is surely the most severely threatened in the Transvaal. They have also furnished us with a handy identification guide having considerable utility in the field of conservation.

J.D. CARR

FLORA OF AUSTRALIA (VOL. 19), Myrtaceae—*Eucalyptus, Angophora* by G.M. CHIPPENDALE. 1988. *Australian Government Publishing Service*, G.P.O. Box 84, Canberra, A.C.T. 2601. Pp. 542, line drawings, eight colour plates, maps. Price: soft cover edn, Cat. No. 88 0515 5, US $44,95; case bound edn, Cat. No. 87 0157 2, US $59,95.

This welcome addition to the *Flora of Australia* covers the two closely related genera *Eucalyptus* and *Angophora*. The former has become a familiar part of the South African scene since its first introduction 150 years ago and plays a major rôle in the economy; the latter, while less commonplace, has secured a small niche for itself in the realm of arboriculture.

To botanists and foresters in South Africa, particularly, the volume under review represents a refreshingly pragmatic approach to the subjects of eucalypt classification and identification. In a number of important respects it departs significantly from the several monographic treatments that have appeared since the mid-nineteenth century.

A concise account of *Eucalyptus* L'Hérit., embracing its chief morphological features, distribution and uses, is followed by a brief review of additional floral and other characters which, although of taxonomic significance, are not mentioned either in the foregoing or in the succeeding descriptions of individual species (which go to make up the great bulk of the volume). The discussion centres chiefly round stamens and anthers, the operculum, ovules and the cotyledons, and reference is made to the use of these organs by previous authors to separate taxa and groups of taxa within the genus. Bentham (1867) in *Flora australiensis*, followed by Von Mueller (1879–1884) in *Eucalyptographia*, based his series largely on staminal characters. Blakely (1934) in *A key to the eucalypts* also used stamens, particularly anthers, as a basis for his classification of species into sections. The result was not altogether satisfactory, for when other characters were taken into account, his classification was seen to be 'artificial'. Moreover Blakely's key was found unworkable in practice by South African forest botanists. Maiden (1929–1931) in *A critical review of the genus* Eucalyptus (Vol. VIII, Parts 3–5) arranged the majority of taxa known at the time according to the shape of the cotyledons. Carr & Carr (1959) in *Developmental morphology of the floral organs in* Eucalyptus, showed that the genus could be divided into two groups, the first comprising species with one operculum 'Monocalyptus' and the second those with two 'Symphyomyrtus'.

In the present work a wide range of readily observable features, including habit, bark, phyllotaxy, leaf morphology, inflorescence, flower buds and fruits, is substituted for a single character to separate groups and individual taxa. A dichotomous key in two stages is provided, the first stage differentiating 20 groups of taxa and the second breaking these down to the constituent 513 species, subspecies and varieties. The groups are again 'artificial' in as much as each comprises an assemblage of taxa without close phyletic affinities. Geographical criteria are incorporated in the second stage of the key, but these are ancillary and seldom if ever critical when deciding which of two alternatives to opt for. A notable contribution in its own right, the key is simple to use and represents a signal advance on previous devices of the kind (Card Sorting Key not excepted).

On taxonomic grounds the genus is divided into 92 series. These do not feature in the key, neither is a synopsis given of the systematic relationships perceived to exist within the genus. The series circumscriptions, are to some extent based on an assessment of those proposed by Pryor & Johnson (1971) in *A classification of the eucalypts*, but nevertheless deviate from them substantially.

Descriptions of individual species need to be read in conjunction with those of the series because characters common throughout a given series are not repeated. However, because the number of species in a series never exceeds 21, this does not require a great deal of manual dexterity or mental agility. The buds and fruits of almost all taxa are illustrated by effective line drawings, which would seem to have been prepared specially for this volume and not merely reproduced from Maiden's *Critical review*. Notes appended to the species descriptions draw attention to distinguishing features and could contribute much to the accuracy and speed of identifications.

The text has been purged of a great many redundant or obscure epithets long bandied about in the botanical and forestry literatures. These have been relegated to the categories of 'presumed hybrids' and 'doubtful names'.

Angophora, comprising seven species, is a straightforward revision of the genus along the lines adopted for *Eucalyptus*.

In the succeeding pages, distribution maps of all the taxa dealt with in the text are given in the same order as that in which the descriptions appear. Although small in scale, they provide a fair indication of the geographical range of each taxon.

Latin diagnoses of new taxa, hitherto unpublished combinations and lectotypifications are all given in an *Appendix*. This is followed by a *Supplementary glossary*, a list of *Abbreviations and contractions*, an *Index* to genera and species and a map of Australia showing *Botanical regions*.

The author points out that recent years have witnessed an upsurge of research on the genus *Eucalyptus*. A number of important papers have been published and others are in preparation. These investigations will doubtless lead to refinements in the classification of the eucalypts as time passes. A review even now in progress is expected to result in many changes being proposed at and above the rank of species. This development was foreshadowed by Johnson (1975) in *Problems of species and genera in* Eucalyptus (Myrtaceae), when he discussed the desirability of splitting off several distinct genera. A decision in this regard would depend on the wideness of polyphylesis in the genus relative to that in other myrtaceous genera and also on 'practical convenience'. Appropos the latter consideration, Johnson poses the question: 'Could the users of botanical names tolerate formal division of *Eucalyptus* into 9 or 10 genera?' He continues: 'Only about 100 species would be in *Eucalyptus* sensu stricto ...'. The reaction of South African forestry practitioners, if not botanists, to such a development would be one of dismay. In the opinion of the reviewer, a move of the kind would seriously damage the credibility of botanical names as aids to communication and the transfer of information. Stability and simplicity are essential if botanical nomenclature is to serve the interests of other disciplines.

South African foresters, and probably the majority of botanists, will be well content with the conservative approach adopted by the author of this volume with respect to taxonomic issues. They would assuredly wish the work to remain the standard reference on the subject for many years to come.

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THE GARDENER'S LABYRINTH by THOMAS HILL, edited by RICHARD MABEY. 1988. *Oxford University Press*, Walton St, Oxford OX2 6DP, England. Pp. 221, 40 colour plates, 110 black and white reproductions, soft cover, stitched. Price: R47,70 + GST.

This delightful production is an augmented version of the first popular gardening book in the English language, which was first published in 1577. It proved very popular and ran to six editions over a period of 75 years. The publication under review is based on the 1652 edition, but excludes Hill's astrologically based notes on medicinal uses of specific plants. It retains, however, a table which serves as a precis of the content of these notes.

Mabey's introduction is a scholarly and entertaining review of Hill's text, as seen in its social, botanical, horticultural, literary and historical perspectives. No apology is needed for quoting from it: 'As a study of plants it is overshadowed by the massive herbals of the Elizabethan botanists Turner and Gerard. Even as a garden encyclopaedia it cannot compare with John Parkinson's *Paradisi in Sole* ... But from its very first pages, *The labyrinth's* descriptions of how to test soil between the fingers, build a rose arch, mulch a vegetable bed, leave you in no doubt that this is a pioneering work ... It is the enthusiastic, coaxing, down-to-earth voice of the incipient garden columnist ... Some of his advice is remarkably precocious ... yet running through the book is a ... to most modern minds, patently impractical line of advice which springs from the old tradition of natural magic ... these passages ... give an insight into this crucial moment in history, when the old beliefs were colliding with the burgeoning mood of reason and practicality'.

The Gardener's labyrinth contains 37 chapters, each with one to two pages of text, copiously illustrated. The chapter headings deal with good garden practice, as varied as:

Of plainer instructions for the chusing of a battle ground, with other matter necessary,

To have a wall of Rosemary of a great height quickly, and

Of helps against Scorpions, Todes, Garden Mice, Weasels, and all other beasts, wasting herbs and fruits.

They are followed by a second part which details the cultivation, qualities, and uses of more than 50 different herbs, vegetables and flowers.

Both parts benefit greatly from Richard Mabey's second contribution, an excellent glossary, identifying plants by their common names, and explaining the terms used. I discovered to my sorrow that a garden was not recognized as a 'battle ground' in the modern sense, but that 'battle' in this context means 'fertile'. I would suggest that for this glossary alone the *Gardener's labyrinth* is worthy of a place on most library shelves. But, undoubtedly, the illustrations also add a great deal. They include contemporary paintings, drawings and engravings, as well as embroidery, skilfully chosen to portray the techniques, beliefs, moods, landscapes, cultivars and bounty of those times. The colour reproductions are generally good, but a number of the black and white prints suffer from very uneven register. This failing aside, the *Gardener's labyrinth* is extremely rewarding, both in text and illustration. It invokes humility and wonderment that so much was known and thought about, so long ago, and that some of it has been forgotten. An educational treat.

M.J. WELLS

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